AN IMPLEMENTATION MODEL FOR DESIGN-BUILD (D-B) PROJECT DELIVERY SYSTEM

BY

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DEDICATION

To

My Beloved Parents

Brother and Sisters

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All praises are for ALLAH (SWT), the most compassionate and the most merciful who gave me the courage and patience to accomplish this work. May peace and blessings be upon prophet Muhammad (PBUH), his family and his companions

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THESIS ABSTRACT

NAME OF STUDENT:	**MOHAMMED RIAZ JAWEED**
TITLE OF STUDY:	**An Implementation Model for Design-Build (DB) Project Delivery System**
MAJOR FIELD:	**Construction Engineering & Management**
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The Design-Build project delivery method has experienced extraordinary growth in recent times. Current projections suggest continued growth of Design-Build. In a questionnaire survey carried out in Saudi Arabia, public clients selected Design-Build as the most appropriate procurement system for their projects. This shows that there will be substantial growth in the use of Design-Build in Saudi Arabia in the future. The increased understanding of Design-Build will help in its successful implementation. The study aimed to develop a Design-Build implementation model.

The model is divided into 7 distinct phases. These are identification of facilities for Design-Build, program definition, request for qualification, prequalification, request for proposal, proposal evaluation and performance of contract administration. Each phase is then explained in detail with all the sub factors in each phase. A software tool is developed which explains all the 7 phases in considerable detail, providing all the information required in implementing the Design-Build project delivery method successfully. The software tool guides the owner through the whole process of Design-Build implementation from the initial phase of identification of facilities for Design-Build to the final phase of contract administration in a systematic manner.

ملخص البحث

اسم الباحث: محمد رياض جاويد

مسمى البحث: نموذج لتطبيق أسلوب التصميم والإنشاء

التخصص: هندسة و إدارة تشييد

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شهدت المشاريع بأسلوب التصميم و الإنشاء نموا غير عادي في الفترات الأخيرة. الوضع الحالي يشير إلى استمرار النمو بهذا الأسلوب من المشاريع. في استطلاع أجري على مجموعة من ملاك المشاريع في المملكة العربية السعودية، اختير أسلوب التصميم والإنشاء كأفضل أسلوب لتنفيذ المشاريع. مما يشير إلى أن مستقبلا زاهرا ينتظر هذا الأسلوب الإنشائي في المملكة العربية السعودية.إن الفهم والإدراك المتصاعد لهذا الأسلوب الإنشائي سيساعد مما لا شك فيه على نجاح تطبيقه. تهدف هذه الدراسة إلى تقديم نموذج لتطبيق أسلوب التصميم والإنشاء.

النموذج مقسم إلى سبعة مراحل كالتالي، تعريف المنشأة التي سيتم تصميمها وبناؤها، تعريف البرنامج، طلب للتأهيل، متطلبات التأهيل، طلب المقترح، تقييم المقترح، وأخيرا إدارة العقود.كل مرحلة موضحة بالتفصيل مع عواملها الفرعية. لقد تم تجهيز برنامج حاسبي لتفصيل كل مرحلة بمعرفة جميع المعلومات اللازمة لبناء نموذج للتصميم والإنشاء بطريقة ناجحة. البرنامج يرشد المالك بطريقة انتظامية من المراحل الابتدائية إلى آخر مرحلة لإدارة العقود.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The construction industry is the backbone of many countries. In this respect, the importance of a healthy construction industry in such countries is beyond doubt. Industry wide studies on the performance of the construction industry have pointed to some key improvement areas, one of which is the use of an appropriate procurement method. Procurement is critical as it determines the overall framework embracing the structure of responsibilities and authorities for participants within the building process. Therefore it is a key factor contributing to project success. ***(Cheung et.al, 2001)***

Obtaining a project within a predefined time, cost and quality is the ultimate goal of the clients. Though projects have become more complex and quality standards of the building projects have increased, much less time and cost have been allocated in the designing, bidding, planning and construction of building projects. Also, the need for more financial planning and fewer amounts of contracts has increased the possibility of looking out for new construction procurement methods. Insufficient attention has been given to how clients will systematically incorporate the new procurement methods not only to their

own advantage but to attract the interest and energy of private producers. ***(Miller & Evje, 1999)***

1.2 Statement of the Problem

The engineering and construction industry faces formidable challenges. As a whole, the industry worldwide continues to perform unsatisfactorily. It suffers from low profit margin, persistent project overruns in schedule and budget, and it is plagued with claims and counter claims. A recent UK construction industry survey showed that profit margin on construction work is 1-2%. The construction industry receives many criticisms. Current practices and mechanisms of the construction industry are inherently inefficient, which inevitably leads to waste. ***(Yeo & Ning, 2002)***

The CII in the US, in their industry-wide investigation, concludes that project performance measured in terms of cost, schedule, technical quality, safety and profit objectives has room for substantial improvement for the industry as a whole. It is reckoned that 25% time saving is achievable in a typical construction work package without increasing allocated resources. ***(Yeo& Ning, 2002)***

Construction industry performance can be improved by use of an appropriate project delivery method. There are various factors which must be taken into consideration before selecting a particular project delivery method like type of project, project schedule, constructability challenges, project budget and project complexity so that the project can be completed on time, within budget and with the required quality.

The decision of which project delivery method to use should be made early in the life of the project and preferably during the predesign phase. No decision should be made

however, until all the parties have agreed on what delivery methods are available and what they are called. Once this initial discussion has been completed, the unique requirements of the project should be considered and tested against the attributes of each of the delivery methods. When the most appropriate delivery method has been determined, then all external factors such as legal requirements and funding availability should be considered. ***(Georgia state Financing and Investment commission, 2001)***

1.3 Significance of the Study

The study aims at developing a model for Design-Build project delivery method implementation. It includes all the phases for implementing Design-Build from project identification to contract administration. The Design-Build project delivery method has experienced extraordinary growth in recent years. Since 1986 there has been continued growth in Design-Build construction in terms of previous volume and as a percentage of total construction. Current projections suggest continued growth of Design-Build. The US Department of Commerce predicts that Design-Build will account for half of all non-residential construction by the year 2001. ***(Songer et.al, 2002)*** An inevitable outcome of this growth is the increased entry into the market by both contractors and architect-engineers (AE's) possessing little or no design experience. Additionally, such growth suggests an increase in owners selecting design-build for the first time. Continued success of the Design-Build method requires documentation and dissemination of fundamental Design-Build knowledge to these new participants. Therefore, to enhance owner selection of appropriate projects and to provide Design-Build services, the AE, construction and

owner communities must improve their understanding of owner attitudes toward selecting Design-Build as a preferred delivery method. ***(Songer et.al, 2002)***

A questionnaire survey was carried out in Saudi Arabia to select the most appropriate procurement system for the implementation of their projects. The results showed that Saudi public clients selected design and build as the most appropriate procurement system for their projects. ***(Alhazmi& Caffer, 2000)*** This shows that there will be substantial growth in the use of Design-Build in Saudi Arabia in future. The increased understanding of the Design-Build project delivery method will help in the successful implementation of this fast growing delivery method.

According to a survey carried out in the Eastern Province of Saudi Arabia, from among the top five potential dissonances in a construction project, the top was found to be "lack of coordination between professionals". ***(Arain, 2002)*** This problem can be overcome by using the Design-Build project delivery method, since all the professionals will be working together for the owner. Dissonances between the designer and contractor initiate barriers in the design phase and construction process. Design and construction of a project in a most amicable environment to achieve the conformity of the project with cost, quality and schedule can be achieved by the Design-Build project delivery method. The method provides the concerned project authorities with minimum conflicts and interface dissonances among them as the project is managed by a single entity to ensure the achievability of required goals of the project, thereby eliminating the dissonances. Regardless of its size and volume, the most important issue that matters to keep the project on track from the inception to the completion is the better coordination of the designer and contractor from the beginning phase of the project.

1.4 Objectives

The objectives of the research are:

1. To get a greater understanding of the Design-Build method

2. To identify positive factors favoring the use of the Design-Build method

3. To develop a Design-Build model

4. Finally, to create a software tool based on the model for effective implementation of the Design-Build method

CHAPTER 2

LITERATURE ANALYSIS

2.1 Project Delivery Method

The term "Project delivery method" means the approach used to organize the project so as to manage the entire designing and building process ***(Gould, 2002).*** Project Delivery is a comprehensive method by which a product is defined and constructed

Following requirements fulfill the complete definition of project delivery:

- For a Project, its scope and requirements should be clearly stated
- Method of procedure, actions, and order of events should be decided.
- Contractual requirements, responsibilities and obligations should be established
- Forming and documentation of agreement
- Actual design and construction
- Handing over the project to the owner.

"Project delivery method" is a method for procurement by which the owner's assignment of "delivery" risk and performance for design and construction has been transferred to another party (or parties). These parties typically are a design entity, who takes responsibility for the design, and a contractor who takes responsibility for the

performance of the construction. ***(Georgia state financing and Investment commission, 2001)***

Project delivery systems consist of the procedures used in the business of design and construction to manage the costs, schedule, and quality elements of creating a new or remodeled facility. ***(Beard, et.al, 2001)***

Depending on the applicable legal requirements, there are limited project delivery methods with unlimited hybrids and variations. The decision of which to use should be early in the life of the project and preferably during the predesign phase. ***(Georgia state financing and Investment commission, 2001)*** In the private sector these delivery methods offer clients the chance to shift emphasis towards core functions and a way from real estate development and operations. In the public sector, where budgets are constrained, delivery alternatives offer clients the chance to combine construction skills and technology to meet infrastructure needs in innovative ways. ***(Miller & Evje, 1999)***

2.2 Evolution of Project Delivery Method

Obtaining a project within a predefined time, cost and quality is the ultimate goal of the clients. Though projects have become more complex and quality standards of building projects has increased, very less time and cost has been given in the designing, bidding, planning and construction of building projects. Also the need for more need of financial planning and fewer amounts of contracts has increased the possibility of looking out for new construction procurement methods. ***(Miller & Evje, 1999)*** Clients are also striving to minimize their risk exposure. These factors together with the need for a greater degree of financial planning and a lesser amount of contract administration have brought pressure

to explore new options for construction procurement. ***(Thomas & Skitmore, 2002)***.In addition to design-bid-build (DBB) and design-build (DB) , a litany of new terms describe the new infrastructure delivery methods: public-private partnerships (ppp), turnkey (TKY) , design-build-operate (DBO), design-build-operate-transfer (DBOT), design-build-operate-maintain (DBOM), design-build-improve-operate (DBIO), build-operate-transfer (BOT), and build-own-operate-transfer (BOOT).New acronyms will emerge as producers of construction related services struggle for marketing strategies that yield new work in a volatile business environment. ***(Miller& Evje, 1999)***

2.3 Role of Project Delivery Method in Project Success

The construction industry is one of the backbones of the economy of many countries. In this respect the importance of a healthy construction industry in such countries is beyond doubt. Industry-wide studies on the performance of the construction industry have pointed to some key improvements areas, one of which is the use of an appropriate procurement method. Procurement is critical as it determines the overall framework embracing the structure of responsibilities and authorities for participants within the building process. Therefore it is a key factor contributing to project success. ***(Cheung et.al, 2001)*** The choice of procurement route for construction work is one of the many important decisions that construction clients have to make. It is based on several factors such as the time available, complexity of the project, desired flexibility in making changes, degree of price certainty, performance requirements, the client's advisor and the balance of risks and responsibilities for various aspects of the project. The choice of the route which best matches the client's requirements can then be made based on the relative

advantages of the alternatives against the criteria defined by the client. (***Anumba & Evbuomwan, 1997)***

2.4 Classification of Project Delivery Method

Pietroforte & Miller (2002) classified project delivery method according to two dimensions: the type of project delivery and the choice of project finance method. As shown in Figure 2.1 vertical axis represents a continuum in which funding responsibilities (i.e. financial risks) for producing, operating and maintaining a facility are shifted from government (direct funding) to private investors (indirect funding). The horizontal axis instead, represents the extent according to which the various phases of a facility life cycle are procured separately (segmented procurement) or combined with each other (combined procurement). These two axes form four quadrants according to which different types of project delivery systems are classified. The right end of the horizontal axis encompasses the procurement of both project and operational phases of a facility life cycle. As shown in Figure 2.1 in Quadrant IV, design-bid-build (DBB), Design-build (DB) ,Turnkey are the most representative delivery systems of a client's policy that is based on direct funding and segmented procurement. In the case of Design-bid-build (DBB), for example a client provides the funding for all the various phases of a project including the completion of full design before tender. The services required for the completion of each phase are produced separately. In the approach of Quadrant IV infrastructure planning by government focuses only on the initial capital cost of a facility and it assumes a continuous stream of future funds (from taxation and/or user charges) is

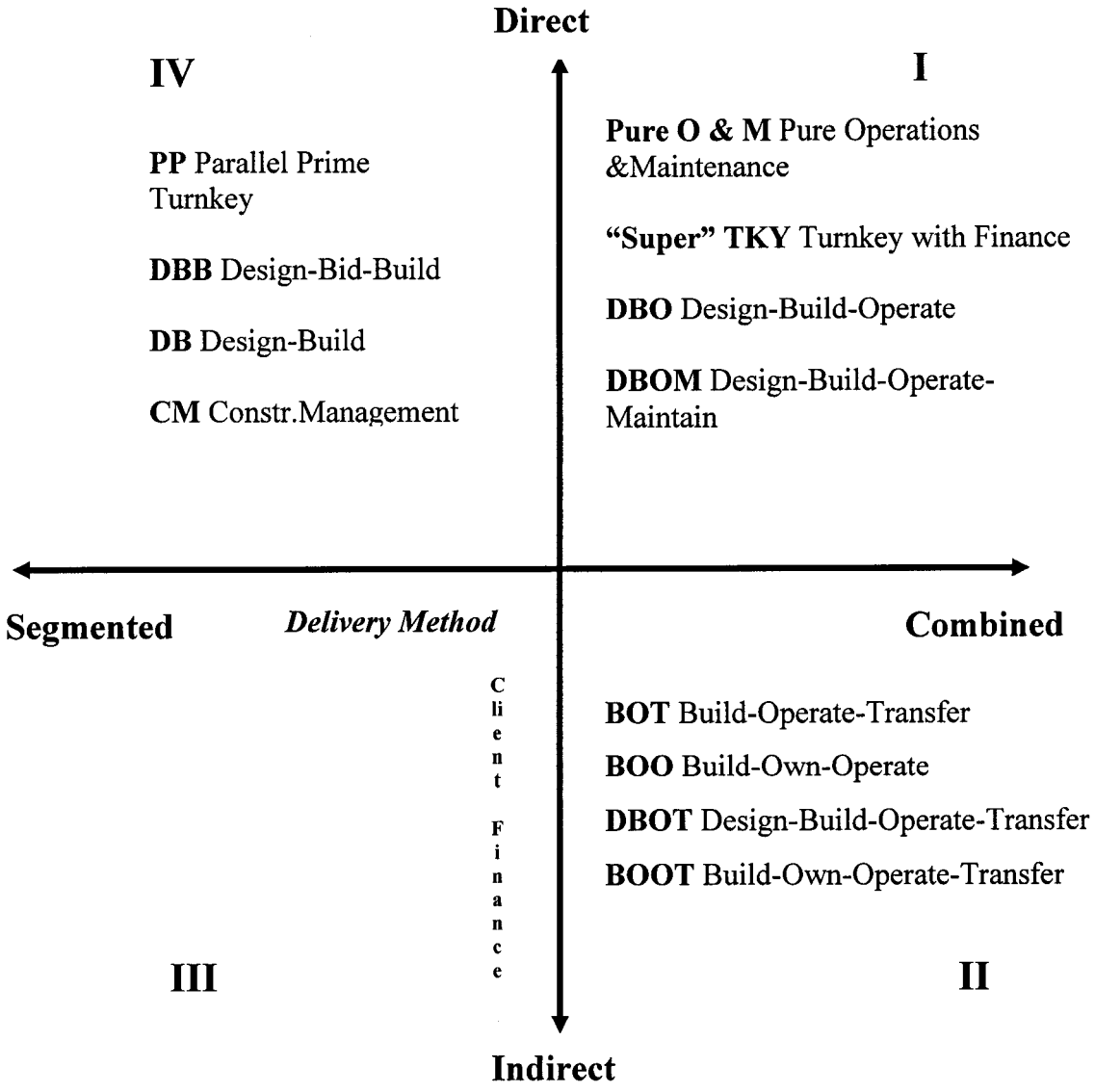

Figure 2.1: Classification of project delivery methods according to four quadrants

Source: Roberto *Pietroforte*, John B. *Miller*, 2002

made available for the maintenance, replacement and final replacement of facilities. In most highly developed countries the limits of direct government funding (Quadrant IV and I) are underlined by a growing gap between infrastructure needs and availability of funds through taxation.

This gap is also exacerbated by chronic public deficits. The most commonly used delivery system of Quadrant I: design-build-operate (DBO) is an arrangement in which the client procures design, construction, maintenance and operations from a single party. The cash flow to support these services is directly provided by the client with its own resources through the collection (by the client and at the client's risk) of user charges or through other types of subsidies e.g. preferred credits. The delivery methods of Quadrant II: design-build-finance-operate (DBFO) and its variations are similar to DBO except in one fundamental respect: cash flow to support design, construction, maintenance and operations is generated only from the financial strength of the private investor or the financial viability of the project itself. With this method the government does not provide funding for design, construction or operations. The franchise takes the entire project financial risks in exchange for a stream of future revenues and returns the property to the client at the expiration of the concession or franchise. With this method design, construction, operation and maintenance services are still combined in a single procurement action, but revenue risk is transferred to the franchise. ***(Pietroforte & Miller 2002)***

2.5 Selecting a Project Delivery Method

There are a variety of project delivery systems which suit to specific project based on the characteristics and requirements of project owners and other participants in the construction process have diverse needs in the real estate project construction process. To accommodate these differing needs various options for building a structure have evolved. These various options are referred to as project delivery methods. Methods range from the basic (design-award-build) to the more complex (fast-track and turnkey construction). Each method has its own benefits and disadvantages and some methods are better suited for certain kinds of projects. Consultant's role in assisting clients with these options will depend on precisely when in the building process they were first consulted. For example, the client may contact the consultant at the outset before the architect is selected, after the architect is selected, after both the architect and contractor have been selected. To properly advise a client consultant must know what the choices are for project delivery so that they can assist them with the selection of an appropriate method and with the minimization of risks relating to the selected method. ***(Berman, 1999)***

2.6 Project Delivery Method Selection Models

Procurement is critical as it determines the overall framework embracing the structure of responsibilities and authorities for participants within the building process. Therefore it is a key factor contributing to project success. Nevertheless, procurement strategy selection decisions have been mostly judgmental and hence subject to biases of the decision-maker. In this respect the need to have a more objective and systematic selection model is self-

evident. Developing a model for procurement selection is therefore of strategic importance and several leading research works have been reported. ***(Cheung, et.al, 2001)*** There are various project delivery method selection models available to assist client in selecting an appropriate project delivery method to assist his specific project requirements.

Miller & Evje (1998) presented a tool called CHOICE TM which permits convenient comparisons of alternative for a portfolio capital project and services. CHOICE TM is designed to help formulate a portfolio infrastructure strategy test and adjust it to meet strategic goals within capital constraints. The author feels clients can now dramatically change how project are packaged because key project elements like design, technology, construction, finance, operations, and maintenance can be combined in non-traditional ways to produce projects for public and private owners. This is because virtually all the services, materials and equipments associated with the delivery of capital projects are provided through contracts. However with the availability of a variety of project delivery methods there is the need to compare and contrast the application of these methods not only to a single project but also to collections of projects.

Anumba & Evbuomwan (1977) developed a user-oriented computer model based on concurrent engineering process for Design-Build procurement method which provides for improved processing of construction clients requirements. Concurrent Engineering involves conducting engineering operations in such a way that all functional considerations from design to manufacture are taken into account and solutions to potential problems developed as early as possible. Through this model the author aims to address the limitations of the conventional D & B process. The concurrent engineering

process model for D & B is part of an integrated framework for concurrent life cycle design and construction. The integrated framework is designed to facilitate concurrent design practices within a multi-disciplinary construction project team. The model is designed in three levels. They are integrated design and construction process, design tools and techniques and third level represents knowledge-base and databases that act as repositories for information on design codes and standards, design rules, construction materials, components, techniques, processes and operations, the evolving product model, and corporate design data. Client's requirements within the new D & B process are based on a user oriented computer model. It consists of three key stages: Requirements Identification, Requirements Analysis and Prioritization, and Requirements Translation. According to the author some of the benefits of the new process model are framework for identifying and prioritizing client requirements, encapsulations of the clients requirements in a solution-neutral format permitting tendering consortia to be innovative, large amount of rework and duplication inherent in the conventional procedure can be dispensed with delays, disputes and claims which often result from existing procedure can be reduce saving time and money.

Cheung et.al (2001) developed a selection method using multi-attribute utility technology (MAUT) and the analytical hierarchy process (AHP). The method developed consists of determination of selection criteria, determination of procurement options, collecting utility value for procurement options and collection of selection criteria weightings and a trail run of the model. After a pilot study speed, certainty, flexibility, quality level, complexity, risk avoidance, price competition and point of responsibility were used as criteria for conducting the study. Sequential traditional, accelerated

traditional, competitive design & build, turnkey, management contracting and construction management procurement options were selected for the study. Then the utility value for each selection criteria against various procurement options were collected on the basis of questionnaires send to developers and project management. The utility factor was scored on a scale of 10-110 to avoid any possible imbalance due to the occurrences of zeros. In the criteria of speed both "design-build" and "turnkey" scored high utility values and "sequential traditional" offered highest utility in terms of certainty of cost. For the criterion of "flexibility" management contracting scored highest among all the options. Since procurement strategy selection is a decision based on multiple-criteria AHP was used to drive a set of numerical weights representing the relative importance of the criteria with respect to the selection of procurement strategy. AHP employs pair wise comparisons of selection criteria so as to enhance objectivity and downplay too much subjectivity. The "Expert choice" software was used in the study to carry out the AHP process. Consistency of the comparison is also important. If IR (inconsistency ratio) was less than 0.1, the results were taken as satisfactory. The procurement selection decision chart was organized: the utilities were calculated against each criterion in accordance with the importance weightings and the rankings in accordance with the order of utilities derived were organized. The respondents then compared the proposed option with that actually adopted in their particular project settings. Out of the 15 assessments conducted there were eight matching and seven non-matching observations. Furthermore, the actual procurement strategies used included sequential "traditional" (six numbers), "accelerated traditional" (seven numbers) and "competitive design and build" (one number) suggesting a seemingly dominant use of the

traditional method. According to the author the model was will received and the respondents found it to be useful.

Miller & Evje (1998) presented a model in an attempt to integrate procurement choice alternatives at the portfolio level. The tool uses Microsoft TM Excel 97-98, operated entered data cells, automated "cut and paste" visual basic macros and buttons and links, CHOICETM assists clients search through alternative configurations of the portfolio that can be displayed as presentation summaries and graphics. The author defined the terms infrastructure, project delivery and finance methods, project viability, discounted cash flows which need to be understood in the context of this model. The results of an analysis using CHOICE TM is the development of several viable configurations of the portfolio each of which lists the timing, delivery method and capital commitments required of the government to deliver that particular configuration. In situation where cost exceeds current capital constraint each configuration will present a clear set of executive or legislative choice: project deferral, adjustments in project scope, cancellation, discrete decision about capital constraints and transparent choice as to overall procurement strategy.

Al-khaleel (2002) developed the analytical hierarchy process (AHP) to select the most appropriate delivery method among design-bid-build (DBB) method, design-build (DB) method and the construction management (CM) method. AHP is a multi-criteria decision making method developed by Saaty which has been applied to solve unstructured problems in a variety of decision-making situations ranging from the simple personal decision to the complex capital-intensive decision. The AHP was developed on several factors which were grouped under three major categories. They were project

characteristics; owner's need and owner's preferences. Project characteristics were further divided into sub-factors clarity of scope, schedule, complexity and contract pricing. Owner's needs were further divided based on his requirement into sub-factors of constructability studies; value engineering studies, contract packaging and feasibility studies. Similarly Owner preferences were divided into sub-factors of owner's responsibility, design control and owners involvement after award of contract. The use of AHP model requires the owner's project team to discuss and determine the relative importance of each of the elements in the hierarchy. The alternative to be selected is the one attaining the highest priority value.

2.7 Risk Assessment in Project Delivery Method Selection

According to ***Byrne (2002)*** each project will have its own specific risk profile. Major risk areas are usually described in accordance with the following heading which can be used in assisting the selection of the most appropriate delivery method.

- **Completion Risk** - The risk that the project will not be completed or will completed sufficiently late to affect the viability of the project
- **Construction Cost Risk**- The risk that the project budget will be exceeded
- **Environmental Risk** -The risk that the project will be sensitive to environmental and/or heritage issues
- **Industrial Relations Risk**-The risk that the project will be affected by industrial relations concerns

- **Technological Risk**- The risk that the project will be sensitive to the application of new technologies
- **Operational Risk**- The risk that the facility will not operate within the design specification
- **Market Risk**- The risk that sufficient cash flow will not be generated by the completed facility
- **Political Risk-** The risk that a change in government or in taxation legislation will affect the return on investment

Clients and Tenderers are best served when the project delivery method best suits the overall project requirements. As an initial step to assist the client in the selection of the most appropriate project delivery method the risk profile should be examined for the particular project which is intended to be put to the market to tender. Risk can be analyzed by giving weighting to each risk which can be measure of the importance placed on that particular risk. Each risk is then assessed and rated in terms of both likelihood of occurrence and expected consequence on a scale of 1 (low) to 5 (high) rating. The Score for each risk then is the product of the weighting of each particular type of risk and rating of that same risk. The total score then is the addition of the individual scores for each type of risk considered. ***(http:www.enable.ie/pressreleases/usefuldocs/tenderingguidelines.doc)***

2.8 Types of Construction Contracts

There are numerous contract types used in construction depending on owner and project requirement. Construction contracts are typically drafted by the owner or his representative (consultant) and contain the subject matter and terms and conditions. The construction contract is typically compromised of the following ***(Ashly & Workman, 1986)***

- Bid Form
- Agreement Form
- General Conditions or Standard Specifications
- Special Provisions
- Plans
- Addenda

Construction contracts must also include a compensation system. The typed of contract are typically classified as follows:

2.8.1 Fixed Price contracts

In a single fixed-price contract, also called a lump sum contract, the contractor agrees to provide a specific amount of work for a specific sum. In this contracting method both parties try to fix the conditions of the project as precisely as possible. Once contract is signed both parties must live with its terms

The advantage of this contracting method is that the owner knows before the work begins what the final cost of the project will be. This contracting method is usually used in the

traditional delivery method. The designer will prepare a complete set of contract documents, which the owner then either bids out or negotiates with a contractor. A final contract is agreed to and the work begins. The risk that the owner takes in this contracting method is that the contract is only as good as the accuracy of the contract documents- if the scope of the project changes or if errors exist in the documentation, the contract will need to be renegotiated possibly exposing the owner to increased financial risk ***(Gould, 2002)***

2.8.2 Unit Price Contract

In unit price contract the owner and the contractor agree as to the price that will be charged per unit for the major elements of the project. The owner/designer will typically provide estimated quantities for the project then ask contractors to "bid" the job by calculating unit prices for these items and calculating a final price. Contractor overhead, profit, and other project expenses must be included within the unit prices that are provided. The owner then compares the final prices and selects the low bidder.

The advantage of this type of contracting method is that in many projects (heavy engineering projects being a perfect example) it is difficult to quantify accurately the work necessary. In excavation work it is often difficult to quantify accurately the actual amount of rock versus earth that must be excavated. To eliminate risk to both the owner and the bidders, the designers will estimate quantities and then ask the bidders to provide a unit price for each type of excavation and bid the job. This contracting method provides the owner with a competitive bid situation allowing for a fair price for the work. The risk

to the owner in this contracting method is if estimated quantities are significantly different from the reality of the situation, the financial commitment of the owner may be greater than planned. ***(Gould, 2002)***

2.8.3 Cost Plus Fee

In a cost-plus contract arrangement, also called a reimbursable or a time and materials contract, the contractor works on the project and is reimbursed by the owner for its costs plus is paid either an additional agreed upon fee or is paid a fee that is a percentage of those costs. This contract makes sense when the scope of the project may be difficult to define or when it is important to fast-track the project. This type of contract also allows the contractor, designer and owner to work together early in the design-build process in non-adversarial fashion encouraging value engineering and good estimating and scheduling support. A variation of this type of contract is called a guaranteed maximum price (GMP)

In this type of contract the contractor is reimbursed at cost with an agreed-upon fee up to the GMP which is essentially a cap beyond this point the contractor is responsible for covering any additional costs within the original project scope. It is not unusual to include in this contract an incentive clause, which specifies that the contractor will receive additional profit for bringing the project in under the GMP.The risk the owner is using in this type of contract is that even with a GMP the project is started with considerable unknowns. By using a GMP the project costs may be capped but the quality and scope may be sacrificed at the expense of the GMP. ***(Gould, 2002)***

2.9 Design-Bid-Build (DBB) Project Delivery Method

Design-bid-build (DBB) also known as "Traditional Project Delivery Method" is a segmented delivery method in which design is fully separated from construction both of which are in turn separated from maintenance and operation of the facility. In the "DBB" model the client also separately provides planning and financing of the project. This is a very common type of the project delivery system where the owners contracts separately with a designer and a contractor. The owner normally contracts separately with a designer and a contractor. The owner normally contract with a design company to provide "complete" design documents. The owner or his agent then solicits fixed price bids from contractor to perform the work. Usually one contractor is selected and enters into agreement with the owner to construct the facility in accordance with the plans and specification. This type of contract requires that the project is performed in a linear fashion where the sequence in performing the project starts with designing then bidding and last is construction. This method is used when project is clearly defined; design is unlikely to be changed during construction and when the project does not have a schedule constraint.***(Al-Hammadi, 1999)***A typical arrangement of Design-Bid-Build method is shown in Fig 2.2.

Advantages of Design-Bid-Build

The design-bid-build is considered as an easy delivery method for the contractor since aspects related to project cost are easier to monitor than other types of project delivery method. This method is suitable for the owner whose main objective is the cost since his

effort exerted in coordinating and controlling the work may reduce the cost. The fact track method may be utilized if the schedule of the project is tight and the time is critical for the owner in order to reduce the period of the project. However the overlap between the design and the construction requires more coordination and efforts. The actual price the owner pays for construction is likely to be close to the contract price because the project was completely designed before it was bid. The DBB is the most familiar and understandable project delivery system for all parties associated in construction. During the design phase changes can be done with minimum cost and effort since the construction phase has not started yet. However, in other system such changes may cause a lot of losses. The liability of the involved parties such as owner, A/E, contractor and subcontractors are well defined. ***(Mogibel, 1999)***

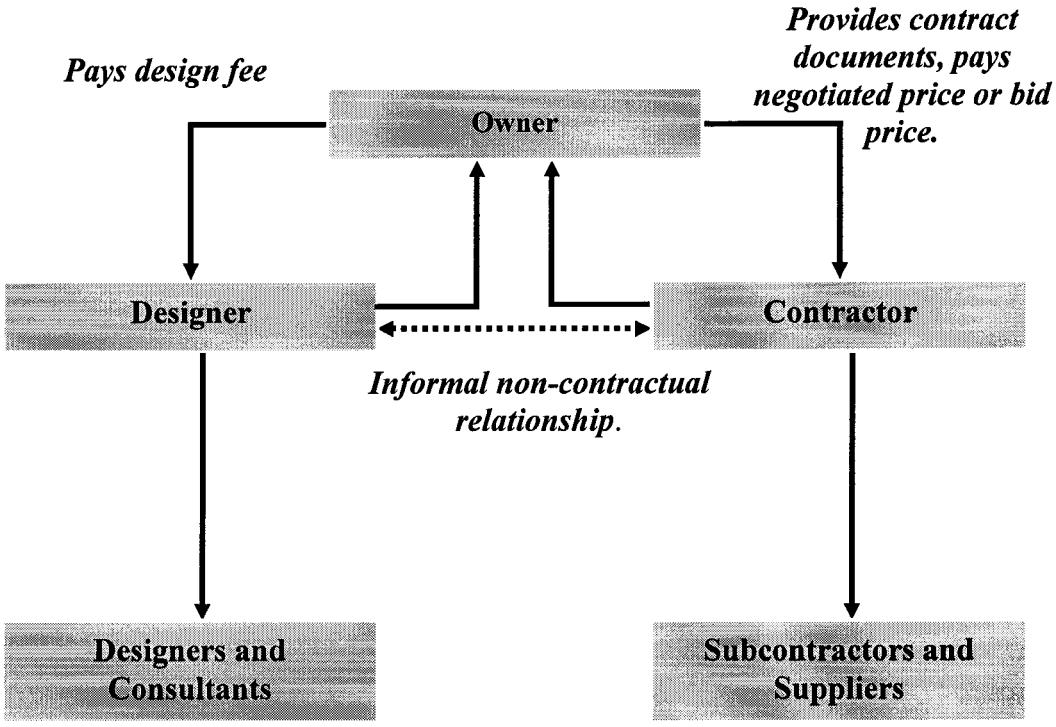

Figure 2.2: Traditional Project Delivery Method

Source: Frederick E.Gould, 2002

Disadvantages of Design-Bid-Build

The quality of the construction might be poor as the selection of the contractor is based on the lowest bidder price. The method requires considerably longer time compared to other type of methods. Also there is a high risk of designing a project that cannot be constructed. ***(Al-Hammadi, 1999)*** In the traditional construction procurement process the client hires a consultancy team made up of experts such as architects, designers and supervisory personnel. While contracting the construction to the selected contractor. The present day multiple needs and complexities of the construction industry often make the use of such a traditional procurement system some what inefficient in terms of cost and time. Further more the adversarial roles often assumed by the various parties in a traditional system may discourage teamwork while leading to avoidable disputes. ***(Palaneeswaran& Kumaraswamy, 2000)***

Although the DBB method promotes the construction of a quality project, because of the inherent tension between the design professional and the contractor this method is often criticized because of the extended time involved in designing and constructing the project as well as the somewhat adversarial mature of the relationship between the architect and the contractor. The two look over each other's shoulder and are all too ready to finger-point if something goes wrong. Because if this situation and others, many variations of this construction method have developed. There is no contract between the architect and the contractor in the DBB method of construction, therefore in dispute the architect and the contractor cannot sue each other except generally in one situation: Most courts will allow the architect and the contactor to sue each other if the other has been negligent; however, even when one of these parties has been negligent, they cannot be forced to join

in an arbitration between the owner and one of these parties unless the owner and the other contracting parties have agreed to permit the joinder of the third-party to the proceeding.*(Berman, 1999)*

2.10 Design-Build (DB) Project Delivery Method

Design-Build (DB) is defined as a delivery strategy in which the client procures both design and construction from a single producer. Initial planning, functional design, financing, maintenance and operation of the facility remain as separate, segmented elements of the project provided by the client. This is an arrangement between the owner and a single entity to perform both the design and construction under a single design-build contract. Portions or all of the design and construction may be performed by the entity or subcontracted to other companies. This is a delivery method that has gained great acceptance by both the owner and the contractor as an optimum delivery method for executing projects. Based on a recent study performed by University of Reading Design and Build Forum to compare the project delivery method used in construction industry has proved that Design-Build delivery method has many advantages over the traditional method. *(Al-Hammadi, 1999)*. A typical arrangement of Design-Build method is shown in Fig 2.3

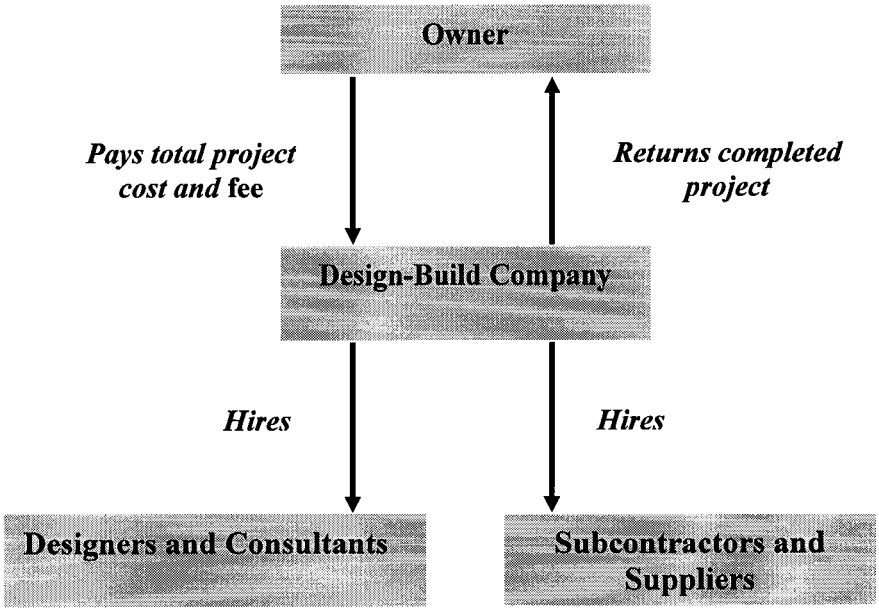

Figure 2.3: Design-Build Project Delivery Method

Source: Frederick *E.Gould, 2002*

Advantages of Design-Build

Design Build offers many advantages such as single-point responsibility, fast-track project delivery, enhanced financial certainty, improved buildability, reduced disputes and increased productivity. The Design-build concept has deep historical roots. In ancient times the "master builder" had full responsibility for all phases of a project including engineering, aesthetic design, plan preparation, drafting and construction. But the design-build approach in the present day context would involve a multi-disciplinary team rather than an omniscient and omnipresent master builder. Design-build now implies a project delivery system whereby both the design and the implementation of that design are performed by the same entity. This single entity, the "design-build contractor" agrees to delver the design and to construct the project either directly using his own resources or with subcontractors and consultants.

Disadvantages of Design-Build

The main disadvantage of this method is that the owner may not be guaranteed that all his interest and requirements are fully satisfied. However the "bridging" process in the DB delivery system can provide protection to the owner. Also the roles of each party involved in the project are not as clear in this method. It can be very costly if the information provided by the owner to the contractor at the outset of the design build process is in error. ***(Mogibel, 1999)***. Sufficient specifications and plans have to be prepared for the bidding job. Also less flexibility for making changes following the award of the contract.***(Al-Hammadi, 1999)***

2.11 Construction Management (CM) Method

Construction Management (CM) is a project delivery method that can be used as "agency" CM in which the owner contracts with the designer and the contractor while construction manager works as an advisor to the owner. Moreover, construction management at risk is also a kind of project delivery system where the owner contracts separately with a designer and a contractor. The design company performs design services while the contractor performs the construction work as well as the construction management services in accordance with design. ***(Konchar & Savilor, 1995)***

To avoid some of the problems inherent in the traditional design-award-build project it is common for workers to engage a construction manager to perform task such as assisting with the development of accurate construction cost estimates that are within the owners budget, scheduling, technology issues, reviewing the architects plans for constructability, obtaining and negotiating bids and coordination of aspects of the work. ***(Berman, 1999).*** A typical arrangement of construction project management is shown in fig.2.4.

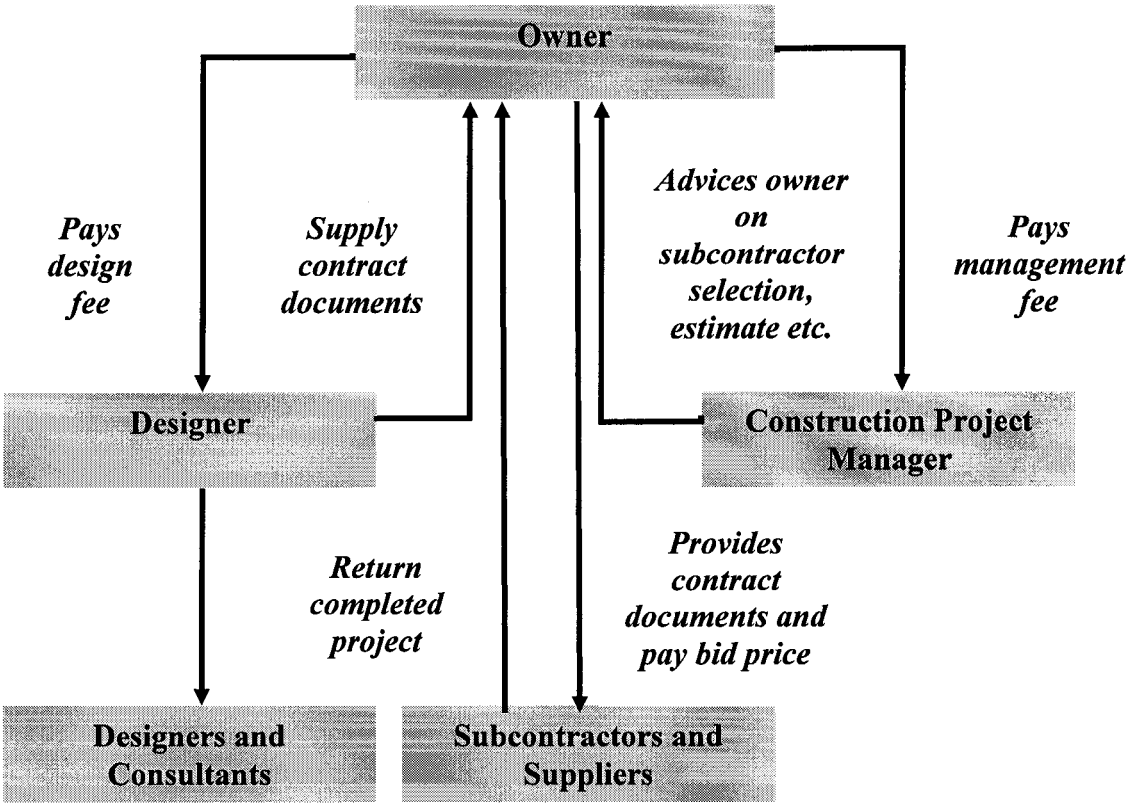

Figure 2.4: Construction Project Management Method

Source: Frederick *E.Gould, 2002*

2.12 Construction Management at risk

The most common form of construction management is when the contractor acts as a construction manager through the design, budgeting and bid procurement phase and then acts as a contractor for some or all of the construction of the project. When the construction manager is also the contractor, the contractor often provides a guaranteed maximum price or some other cost limitation regarding the work. In this situation, the construction manager acting also as the contractor usually contracts directly with the subcontractors for the performance of the work and is responsible to the subcontractors for delays caused by sequencing or coordination errors. When a construction manager becomes responsible for the work, the construction managers relationship with the owner shifts from that of an advisor to that of a vendor which increases the construction managers liability to the owner. The construction manager becomes responsible to the owner and the subcontractors for problems with cost and scheduling. ***(Berman, 1999)***

Advantages of CM at Risk

The construction Management method provides the owner with the opportunity to perform design review, constructability review and value engineering prior to the starting of construction. This will enhance the chances of project success in terms of quality, time and cost. It is very useful in project employing multiple prime contractors in which coordination is very essential for the success of the project. The construction management method plays an effective role in reducing and resolving the claims and disputes among

parties involved in the project. The CM balances the design with the construction schedule when fast track method is used since the design change may lead to a delay in the project. ***(Mogaibel, 1999)***

Disadvantages of CM at Risk

There are still two contracts for the owner to manage. Any major disagreement on the project has to go through the owner for resolution. Construction input may not be included by the designer. Although the CM-at-risk process sets up a relationship wherein the designer has input from the constructor during design, it is seldom mandatory for the designer to accept any of the constructions ideas. Firm costs for the project are seldom known until later.CM-at-risk project delivery is slower than design-build. ***(Beard.et.al, 2001).***The success of the CM delivery system is very sensitive to the proper selection of a qualified CM services provider. If an unqualified one is chosen, the owner will have problem during the design and construction process may require larger amount of overhead cost for staff to monitor costs. The owner is liable for the action of the construction manager since the construction manager is the owner's agent. ***(Mogaibel, 1999)***

2.13 Multiple Prime Contracting

Another alternative procurement system is multiple prime contracting in which the owner holds separate contracts with contractors of various disciplines such as general construction, structural, mechanical and electrical. In this system the owner or its CM

manages the overall schedule and budget during the entire construction phase. This system which many state agencies are required to use gained favor in part as another method of "fast-tracking" construction.

Advantages of Multiple Prime Contracting

Work in each construction discipline is bid separately allowing the flexibility of awarding construction contracts on the first portions of the project as soon as the respective aspect of design is completed. This fast-track approach appears to be a highly desirable feature of this method of procurement in cases where time of performance is a critical element. Furthermore the system allows the owner to have more control over the project schedule, since the owner sets the schedule for bidding individual portions of the work. For example if an initial phase of construction (such as foundation construction) is delayed the owner may reduce liability for delays by postponing the bidding of follow-on-work. Another advantage of this system is that the owner can realize savings by directly procuring major material items such as structural steel or major mechanical equipment avoiding contractor mark-ups.

Disadvantages of Multiple Prime Contracting

However the very nature of this system is one of its primary disadvantage. There have been numerous cases where this method did not work will due to the absence of overall authority and coordination once construction is underway. The problem primarily arises from lack of coordination and contractor delay issues. While the general construction

prime contractor is often given contractual responsibility to coordinate the work among trades including schedule, this contractor lacks the contractual authority the contractual authority to dictate the schedule of another contractor.***(Peck, 2001)***

2.14 Public Private Partnership Projects

There is a worldwide trend toward public-private partnerships (PPS) in public infrastructure development aiming to generate greater efficiencies and synergies, increase revenues and reduced deficits/debts, quicker market development, faster foreign investments and increased competition.PPP scenario are promoted to overcome both market failure and government. Neither a purely public nor a purely private approach to infrastructure provision has proven to be sustainable in either the developed or developing world.(***Zhang & Kumraswamy, 2001)***

Properly formulated PPS can provide more efficient outcomes than those provided by either the public or the private sector alone. The private sector with its wide range of managerial, commercial and technical skills spurred on by the profit motive and unencumbered by layers of bureaucracy can reputedly perform certain tasks more efficiently than the government thereby offering potentially huge benefits to the public. Therefore complex public-private relationships and the environment in which they interact should be further examined to synergize both public and private strengths for an overall "win-win" result reflecting divergent objectives. ***(Zhang & Kumaraswamy, 2001)***

Many types of PPPs have been adopted among which "limited term privatization" or the build-operate-transfer (BOT) type project procurement route is a popular vehicle. The

term BOT has generated a string of related acronyms that reflect variations: buy-build-operate (BBO), build-lease-transfer (BLT), build-own-operate (BOO), build-own-operate-maintain (BOOM) ,build-own-operate-transfer (BOOT), build-transfer (BT) , build-transfer-operate (BTO), design-build-finance-operate (DBFO), design-build-operate-maintain (DBOM), develop-operate-transfer (DOT), lease-develop-operate (LDO), rehabilitate-own-operate (ROO), rehabilitate-operate-transfer (ROT) and transfer-own-transfer (TOT).(***Zhang & Kumraswamy, 2001)***

2.15 BOT (Build Operate Transfer)

The concept of Build Operate Transfer (BOT) was developed first in 1984 by the prime ministry of Turkey when it tended to privatize Turkeys public projects ***(Tiong, 1992)***.The BOT is increasingly utilize by some of governments which encourage the privatizing of major projects. In the BOT arrangement the private promoter is granted a concession by the government. The promoter becomes responsible for financing, construction, operation and maintenance of the project for a period of time during which he owns the project and gets the revenue which covers the project cost as well as its profit. After a specified period the project is completely transferred free of charge to the government. ***(Mogaibel, 1999).***Usually in projects where foreign investors are involved in the bidding process the government delegates a BOT project agency to represent it in the implementation of the project and becomes as an agent of the government.***(Nielsen, 1997)***

Infrastructure procured through such BOT-type protocol in different countries includes roads, bridge, ports, airports and railways in the transportation sector: Power,

telecommunication, water supply and waste disposal systems in the utilities sector: and schools, hotels, hospitals, military facilities and prisons. However privatization involves political as well as economic dimensions. Many prerequisites have to be met for successful PPPs.Potential pitfalls and traps may retard BOT- type schemes. Evidently there is a need to summarize multi-country experiences and draw lessons from strengths and weakness in various PPPs.Good practices in relevant legislative, financial, environmental, technological, organization and managerial initiatives should be benchmarked to identify critical factors for overall project success. In such schemes design, build, financing and operational functions are integrated and the skills and expertise of multiple partners are synergized. Performance-based technical specifications encourage innovative design, concurrent engineering of functions, reengineering of processes, lean construction ,avoidance of over specification, new materials and techniques, more efficient allocation and proactive management of risks and more intensive exploitation of assets.***(Zhang & Kumraswamy, 2001)***

However failures of BOT-type occurred in different countries. This is not surprising given the many variables and participants involved and the "learning" phase that they are still experiencing. Recent successes and failure should be studied for procurement improvements in future PPP projects. The rapidly growing body of experience in BOT-type project is unfortunately widely dispersed, inadequately documented and rarely analyzed or compared. This is well worth consolidating into a "BOT body of knowledge" that in turn merits in depth analysis.Crtitical success factors for PPPs include a well established legal system, business friendly environment , fair and transparent project development system that safeguard the interests and rights of both the public and the

private sector, clean administration, open markets and competitions, stable and supportive public client and financially strong, technically competent and managerially outstanding concessionaire consortium.*(Zhang & Kumaraswamy, 2001)*

Figure 2.5 shows the typical contractual structure for a BOT project.*(Ngee et al, 1997)* A BOT mechanism is a complex structure comprising multiple, inter-dependent agreements among various participants. Major participants in a BOT project include government, private company called concessionaire, lenders (Banks), equity investors, contractors, suppliers, operators and financial advisers. Typically the government grants concession to the private sector (concessionaire).The concession is awarded through concession agreement. The concessionaire is responsible for design, finance, construction and operation of the facility. The concessionaire retains the title of ownership during the concessionary period which is normally 10-50 years after which the title of ownership is transferred back to the government. *(Yeo and Tiong, 2000)*

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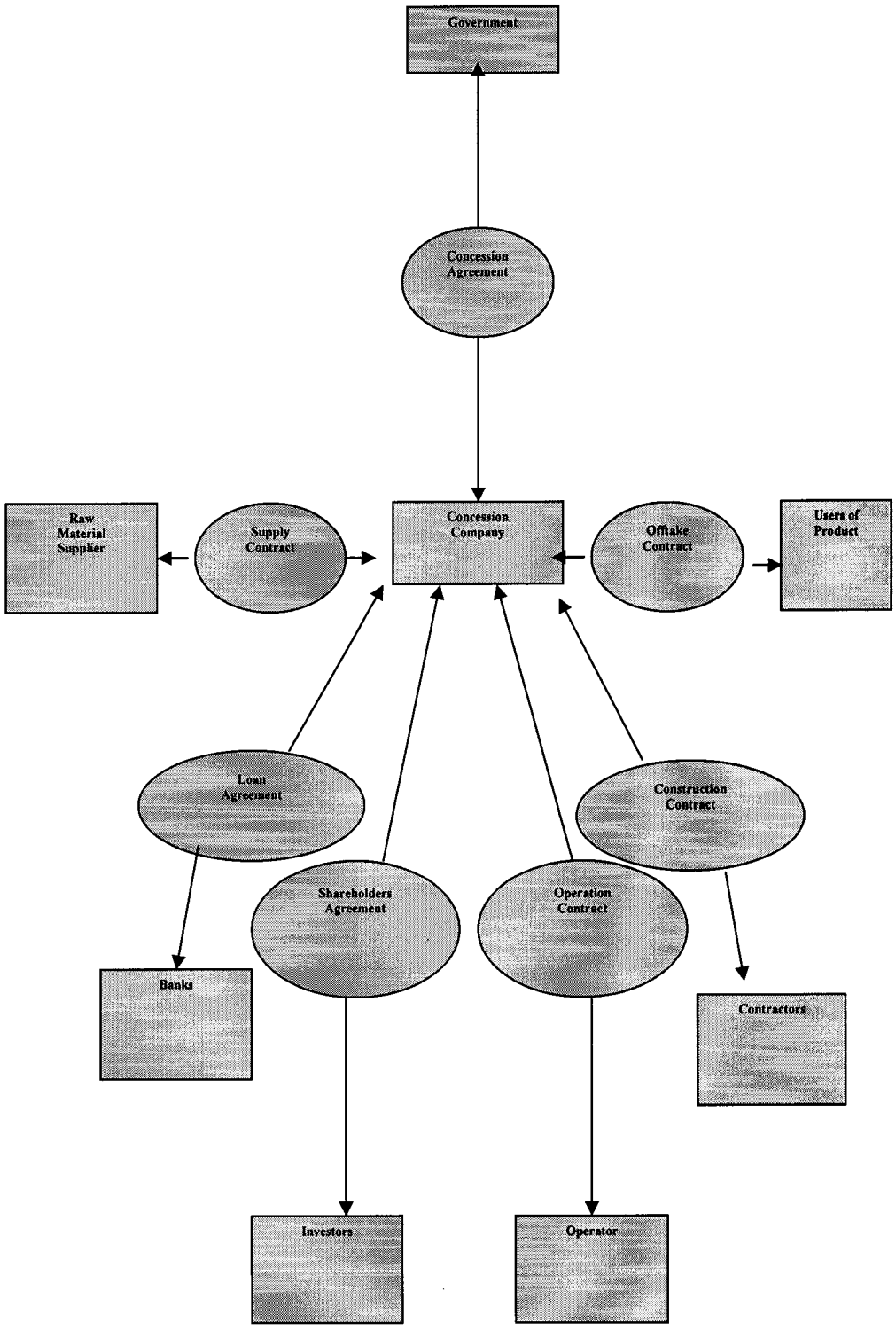


Figure 2.5: BOT Contractual Agreement

Source: Ngee et al, 1997

The concessionaire retains the title of ownership during the concessionary period which is normally 10-50 years after which the title of ownership is transferred back to the government.*(Yeo and Tiong, 2000)*

Advantages of BOT

The BOT method provides the financing mechanism to satisfy the worlds need for more infrastructure development in the rapidly developing countries. Moreover, in less developed countries the BOT provides financing for projects that otherwise may not be build. The concept opens an opportunity for local and foreign contractors to expand the work and increases the probabilities for getting profits. The involvement of the government is minimum during the project which gives the contractor more freedom in selecting the suitable design which satisfies the requirements. *(Mogaibel, 1999)*

Disadvantages of BOT

The BOT method is not an easy process and requires a very high capability of the promoter to meet the requirements of the projects delivered using this method are mostly large projects. The way to win the BOT contract is somehow difficult, time consuming and expensive since the competition is high and the financial risk is also high. Project using the BOT are mostly large project and more participants such as operators, engineers and contractors may participate in the project. However as the project become larger more participants from different countries will be involved and cultural and regional

differences may lead to problems among the participants such as miscommunication which leads to not the achieving the project goal. In using the BOT method the requirements for transferring technology to the local project participants are essential. However this may require training programs which increase the project cost. ***(Mogaibel, 1999)***

2.16 Lean Construction

Lean Construction is a production management based approach to project delivery; a new way to design and build capital facilities. Lean production management has caused a revolution in manufacturing design, supply and assembly. Applied to construction, Lean changes the way work is done throughout the delivery process. Lean construction links the objectives of the production system - maximize value and minimize waste - to specific techniques and applies them in a new project delivery process. Lean Construction is particularly useful on complex, uncertain and quick projects. The fundamental attributes of lean construction are Procurement, Planning and control, supply chain management and partnering. It challenges the belief that there must always be a trade between **time, cost, and quality** ***(Howell & Ballard, 1999)***

Advantages of Lean Construction

•The facility and its delivery process are designed together to better reveal and support customer purposes. Positive iteration within the process is supported and negative iteration reduced

•Work is structured throughout the process to maximize value and to reduce waste at the project delivery level

•Efforts to manage and improve performance are aimed at improving total project performance because it is more important than reducing the cost or increasing the speed of any activity

•"Control" is redefined from "monitoring results" to "making things happen." The performance of the planning and control systems is measured and improved

• The reliable release of work between specialists in design, supply and assembly assures value is delivered to the customer and waste is reduced. Lean construction is a new form of project management and not a productivity improvement program ***(Howell & Ballard, 1999)***

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Methodology

This study investigates the increasing use of the Design-Build project delivery method in the construction industry. A detailed study of the Design-Build process is done. The study identifies the project characteristics, owner requirements, applicable market sectors and previously constructed facilities favoring the use of the Design-Build project delivery method. The study reviews the various elements of the Design-Build project delivery method for its successful implementation. The purpose of the study is to develop a model and create a software tool which would assist all project participants in effectively and successfully implementing Design-Build. The methodology used to achieve the stated objectives is divided into the following phases:

Phase I: Literature Review

Phase II: Identification of Factors Affecting the Use of Design-Build Method

Phase III: Development of the Model and Guidelines for the Use of the Design-Build Method

Phase IV: Creating a Software Tool for Effective Implementation of the Design-Build. Method

•Work is structured throughout the process to maximize value and to reduce waste at the project delivery level

•Efforts to manage and improve performance are aimed at improving total project performance because it is more important than reducing the cost or increasing the speed of any activity

•"Control" is redefined from "monitoring results" to "making things happen." The performance of the planning and control systems is measured and improved

• The reliable release of work between specialists in design, supply and assembly assures value is delivered to the customer and waste is reduced. Lean construction is a new form of project management and not a productivity improvement program ***(Howell & Ballard, 1999)***

3.2 Phase I: Literature Review

The essential objective of this phase was to acquire extensive knowledge about the Design-Build project delivery method. Increasing use of Design-Build in the construction industry was analyzed. The literature review showed that Design-Build is showing good results in comparison to other project delivery methods and its use is increasing. For the purpose of obtaining the required information, various journals, research papers, publications and sources from internet were reviewed. Responsibilities for project participants and challenges for the Design-Build method were studied

3.3 Phase II: Identification of Factors Affecting the Use of Design Build

This phase identified the positive factors favoring the use of Design-Build. A thorough investigation of the various factors which assist in implementing Design-Build was done. Also problems associated with Design-Build implementation were identified. Data regarding the following factors was collected

- Project characteristics favoring the use of Design-Build
- Owner requirements in selecting Design-Build
- Applicable market sectors favoring the use of Design-Build
- Previously constructed facilities assisting in implementing Design-Build

3.4 Phase III: Development of the Model and Guidelines for the Use of the Design-Build Method

This phase will propose a model and associated guidelines for implementing Design-Build. The model is divided into seven distinct phases with a detailed description of all the activities in each phase. In the first phase, facilities favoring the Design-Build method are identified based on project characteristics, owner requirements, applicable market sectors and previously constructed design facilities. The remaining phases describe in detail the whole process of program definition, contractor prequalification, contractor qualification and final agreement between the owner and the Design-Builder

3.5 Phase IV: Creating a Software Tool for Effective Implementation of Design-Build

Based on the model developed, a software tool is created which will guide the owner through the whole process of successful Design-Build implementation. The software tool contains a step by step description of all the activities to be accomplished by the owner from program definition to the signing of the contract with the Design-Builder.

CHAPTER 4

DESIGN BUILD PROCESS

4.1 Design-Build Project Delivery Method

Design-Build is a project delivery method whereby both the design and the implementation of that design is performed by the same entity. This single entity, the "Design-Build contractor," agrees to deliver the design and to construct the project, either directly, using his own resources or with subcontractors and consultants. ***(Palaneeswaran& Kumaraswamy, 2000)***

The single-source approach of design-build consists of a firm or team of architect, engineer and constructor professionals who are at risk for the cost, schedule, quality, and management of the projects. The total cost of construction plus the cost of design are gathered into the design-build contract. Simply stated, the design-builder is both the A/E of record and the at-risk constructor.***(Beard, et.al, 2001)*** In ancient times the "master builder" had full responsibility for all phases of a project including engineering, aesthetic design, plan preparation, drafting and construction for example in the construction of ancient pyramids, churches or temples. But the design-build approach in the present day context

would involve a multidisciplinary team rather than an omniscient and omnipresent master builder. ***(Palaneeswaran & Kumaraswamy, 2000)***

4.2 Design-Build History

Design-Build is a procurement method where one entity or consortium is contractually responsible for both design and construction of a project. Design-Build is not a new concept. In centuries past, it was the only procurement method available. Its roots originate in the ancient "Master Builder" concept where responsibility for both design and construction resided with one person. Design-Build has been traced to ancient Mesopotamia, where the Code of Hammurabi (1800BC) fixed absolute accountability upon master builders for both design and construction. In classical Greece, great temples, public buildings and civil works were both designed and built by master builders. Enduring structures such as the Parthenon and Theater of Dionysus are testimony to this master builder process. ***(Songer et al, 2002)***

4.3 Increasing Use of Design-Build

In the traditional construction procurement process, the client hires consultancy team made up of experts such as architects, designers, project managers, quantity surveyors/cost engineers and supervisory personnel, while contracting the construction to the selected contractor. The present day multiple needs and complexities of the construction industry make the use of such a traditional procurement system somewhat inefficient in terms of cost and time. Furthermore, the adversarial roles often assumed by the various parties in a traditional system may discourage teamwork while leading to avoidable disputes. In such

situations, the Design-Build route offers an alternative with its many evident advantages such as single-point responsibility, fast-track project delivery, enhanced financial certainty, improved buildability, reduced disputes and increased productivity. ***(Palaneeswaran & Kumaraswamy, 2000)***

Design-Build procurement provides opportunities for innovation and excellence while also rewarding both clients and contractors who choose that route. The team approach also helps to defuse the historically adversarial "charged" construction environment. The aim should be to optimize the project design, schedule, and quality while fostering pleasant and therefore constructive working relationships and rewarding environment can be targeted by the correct selection of a contractor. ***(Palaneeswaran& Kumaraswamy, 2000)***

Incorporating the Design-Build process provides one with the means to overcome some of the fragmentation in the construction industry, as it inherently requires more coordination and communication. It also fosters partnering or joint ventures, between firms that would normally have an adversarial relationship, which in turn creates shared goals. The net result should be the creation of an environment that works toward a collective future, one where all parties benefit including E/C firms, public and private owners, consumers, taxpayers, and end-users. ***(Yates, Nov/Dec, 1995)***

Design-Build approach is already an accepted approach in many parts of the world. Design-Build projects can be found throughout the world where there are public-private partnerships for the construction of bridges, tunnels, highways, water-supply systems and so on. The Design-Build approach is also used to help ensure lower risk and lower cost to the public sector. It is also useful for projects that require rapid implementation of public

work schedules. Schedules can be accelerated using the Design-Build approach as long as the design and finished product criteria are clearly defined by the owner early in the design process. Third party influence or interference can be properly managed by the owner or designated to be clearly included in the scope of the Design-Build contract. ***(Yates, Nov/Dec, 1995)***

As with any new technique or method the Design-Build approach offers both advantages and disadvantages both of which must be weighed to determine whether it is a viable approach. Some of the disadvantages associated with Design-Build method are loss of the potential professional the architect engineer. Owners may receive different advice from the A/E on a design-build project than if the A/E was independent. In Design-Build project the numbers of checks and balances are reduced which means the final project may not be up to the owner's expectations. As with any turnkey project, the total project cost may not be established until construction is underway. This requires financial flexibility on the part of the owners, which many clients cannot afford (especially public owners). When two entities or firm joins to perform a Design-Build project each entity loses its individual identity and becomes part of the joint effort. As part of this combined effort each party involved experiences a reduction in profit as well as increased risk to its organization and the full-time commitment of its key staff. ***(Yates, Nov/Dec, 1995)***

4.4 Positive Factors favoring the use of Design-Build

Single Point of Responsibility

The owner who employs Design-Build delivery has a single point of contact for all questions regarding the design and delivery of the facility. The Design-Build entity is responsible for quality, budget, schedule and performance of the completed facility. With the single point of contact, owners can concentrate on definition of needs and timely decision-making, rather than on coordination between designer and builder.

All parties treated as professionals

Design-Build places the designer and constructor on equal professional footing from a business standpoint so that they can provide unified recommendations and jointly developed solutions to the owner.

Time savings

Design-Build is considered to be the fastest project delivery system because it encourages overlapping of design and construction phases. Bidding periods and redesign, two events that can occur with traditional design-bid-build are eliminated. Materials and equipment procurement, and advance construction work may progress before construction documents are completed. The resulting time saving provides the owner with lower costs and earlier use or occupancy of the facility.

Early knowledge of firm costs

Guaranteed project cost can be known much earlier in the Design-Build process. The same entity that is responsible for the design is at the same time conducting cost estimates as the design evolves providing accurate costs for the completed project while the design is only at the conceptual stage. The owner can make an informed decision to proceed with the project with reassurance about scope and final project cost.

Higher Quality

Singular responsibility for design and construction motivates the design-builder. The Design-Build entity has total responsibility for the finished product and cannot shift design errors or construction defects to another party. Traditional design-bid-build contracts rely on restrictive wording, adversarial audit and inspection requirements and the legal system to attain project quality.

Cost-effectiveness of design-build

Design and construction personnel who are working and communicating as a unit can evaluate alternatives choosing systems, methods and materials that enhance the project. Value engineering and constructability are part of the ongoing process and work most effectively when the designers, constructors, specialty contractors, materials suppliers and manufacturers are in constant and concurrent communication during the project. A university research has also shown that cost growth on Design-Build projects is lower than with design-bid-build or CM at risk resulting in the most cost-effective final project for the owner.

Encourages Innovation

Design-Build is the one project delivery methodology that elicits creative responses from the project teams. Normally, the ability to innovate in design and construction is severely curtailed by the use of prescriptive specifications. With Design-Build, performance requirements are stated and the design-builder may use different solutions to meet the owner's ultimate project goals.

Risks are allocated to the party best able to manage the risk

The Design-Build process allows the contract to assign risks in a way that produces the most efficient agreement among the parties. Risks can be assigned as appropriate to the owner, to the design-builder, shared between the two principal parties, or mitigated by the securing of insurance coverage. All risks can be accounted for, discussed and dealt with in a manner that is at once more clear and comprehensive than with other delivery methods.

Lower claims and litigation

Claims for errors or omissions or for time delays tend to disappear because the Design-Build team would have no one to blame for these shortcomings but itself.

Reduced Administration

Under Design-Build process the potential exists to reduce the owner's administrative tasks. Initially, documenting the program of requirements, preparing request for proposals (RFP) and conducting evaluations will require intensive involvement by senior managers, consultants, and other: However, this effort will be rewarded by a facility that meets their

specific functional and performance needs. After award of the Design-Build contract, the owner will not be required to spend time and effort coordinating and arbitrating between separate design and construction contracts. While the process does require the owner to provide "prudent oversight" of the design and construction progress, this responsibility is considerably less time-consuming and exposes the owner too far fewer risks than would the traditional separate contracts for design and construction.

Best Value Selection

Design-Build project delivery methods allow the purchaser to compare the quality and scope of a proposed facility with the price offered. Most buildings and civil engineering structures are unique, one-of-a-kind facilities and will likely require a technical and often an aesthetic evaluation to determine their value to the owner. By giving credit in the evaluation and award mechanism for design excellence, materials and systems quality, function efficiency of the plan, the design and construction teams experience, and other intangible factors beyond price, an owner can select a proposal that offers the greatest benefit, and not simply the lower first cost. ***(Beard, et.al, 2001)***

4.5 Problems with Design-Build Method

Unfamiliarity with the process

Both owners and practitioners may not have used Design-Build delivery in the past. Changing corporate cultures to a collaborative rather than an adversarial process can take some time. Also with Design-Build, owners can be pushed for earlier and timely decision about the project

Communicating owner's needs in Design-Build is different

The front-end definition process of defining user needs and translating those needs to a facility program and technical performance requirements is a new wrinkle for those who have been comfortable going through traditional design phases. The design-builder wants to receive criteria for design from the owner, not the design itself. Further most design-builders want to submit proposals that define the project as the team proposes to design and construct the facility. They do not want to be relegated to submitting only a "number" signifying the low first cost for constructing the facility.

Barriers in procurement and licensing laws

Procurement laws in some countries mandate the use of separate design and construction contract with different procurement procedures required for design and construction. Similarly licensing laws have been used to prevent the use of combined design and construction contracts by making it impossible for other than a licensed professional to hold a contract under which professional design services will be furnished. ***(Beard, et.al, 2001)***

4.6 Strategies for Design –Build firms to remain competitive

Design-Build competitive selection and contract methods work best when these conditions are observed:

- The projects financing is secure, and that fact is communicated to the proposers

- The owner employs qualifications-based selection procedures leading to a reasonable number of proposers in the final proposal stage

- The owner's needs and expectations are clearly stated and the proposers are likely to have consistently similar understandings of those needs

- The single point of responsibility for design and construction is maintained

- The contract terms make reasonable assignments of risks between owner and design-builder

- The owner's organization is able to make decisions in a timely manner

- A working environment of trust and mutual respect can be established among the owner organization and the design-build team. ***(Beard, et.al, 2001)***

4.7 Unfavorable conditions for Design-Build

- The owner requests complete design-build proposals and the project is speculative and may not be built

- The numbers of design-builders proposing are so many as to discourage real competition or cause the "A teams" to drop out

- The criteria for selection are not clear or their relative values to the owner are not stated

- The projects program is unclear or ambiguous

- The selection panel is not well informed about the projects requirements or is not truly capable of acting independent of outside influence

- The owners program limits innovation and flexibility in facility design, system selection or materials

- The owner insists on absolute design control over all aspects of a facility and is not satisfied by general design definitions and performance guarantees from the design-builder. ***(Beard, et.al, 2001)***

4.8 Comparison among Project Delivery Method

A report entitled "Comparison of U.S Project Delivery Systems" by Mark Konchar and Victor Sanvido empirically compared cost, schedule and quality performance of the three primary U.S project delivery methods. It utilized project-specific data collected from 351 building projects. ***(Beard, et.al, 2001)***

4.8.1 Quality as a measure of success

In the Konchar-Sanvido study, quality performance was measured in seven specific areas as shown in Table 4.1.The facility owners were asked to rank the actual performance of the facility versus expected performance. A high score of 10 indicates that the listed system had exceeded the quality expectations of the client. A score of five shows that the owner's expectations were being met whereas; a system scoring zero was not meeting the owner's expectations.

It can be noted from Table 4.1 that Design-Build method significantly outperformed design-bid-build in every quality measure criterion and that Design-Build and construction management at risk were comparable in many categories.

Mean Quality Scores by Project Delivery Method

Quality Measure	CMR	D/B	D/B/B	MSE
Start –Up	7.43	7.5	5.96	.19
Callbacks	8.07	7.94	7.04	.19
Operation and maintenance cost	6.69	7.67	6.88	.19
Envelope, roof, structure, and foundation	5.36	5.71	4.95	.19
Interior space and layout	6.28	6.15	5.19	.19
Environment	5.34	5.24	4.86	.19
Process equipment and layout	5.63	5.61	5.07	.19

Table 4.1: Mean Quality Scores by Project Delivery Method

Note: D/B = design-build; D/B/B = design-bid-build; CMR = construction management at risk; MSE= maximum standard error

4.8.2 Unit Cost Comparison

The effects of project delivery methods on unit cost as shown in Fig.4.1 indicate that Design-Build projects are at least 6.1 percent less costly than comparable design-bid-build projects and 4.5 percent less costly than construction management at risk projects on the average.

4.8.3 Construction speed comparison

As shown in Fig: 4.2 When all other variables were held constant, the effects of project delivery methods indicate that Design-Build projects are at least 12 percent faster than design-bid-build projects and 7 percent faster than construction management at risk (CMR) projects on average in terms of construction speed.

4.8.4 Project delivery speed comparison

Comparing similar projects (i.e. size, unit cost, predesign, facility type and team communications) Design-Build projects were found to be at least 33.5 percent faster than design-bid-build projects and 23.5 percent faster than construction management at risk projects on average in terms of project delivery when design and construction durations were included as shown in Fig: 4.3

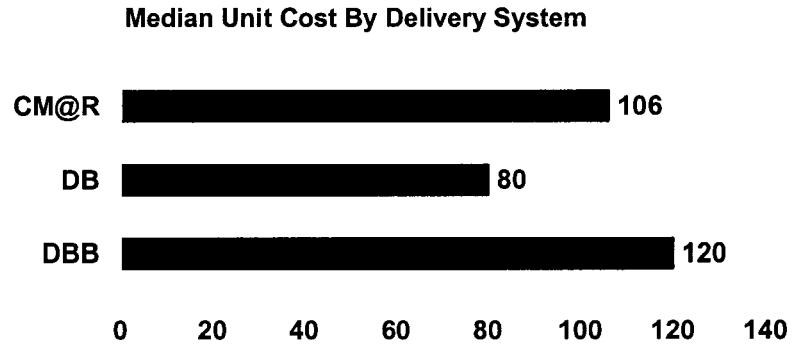


Figure 4.1: Median Unit Cost ($/Sq.ft)
Source: Jeffrey L. Beard, et.al, 2001

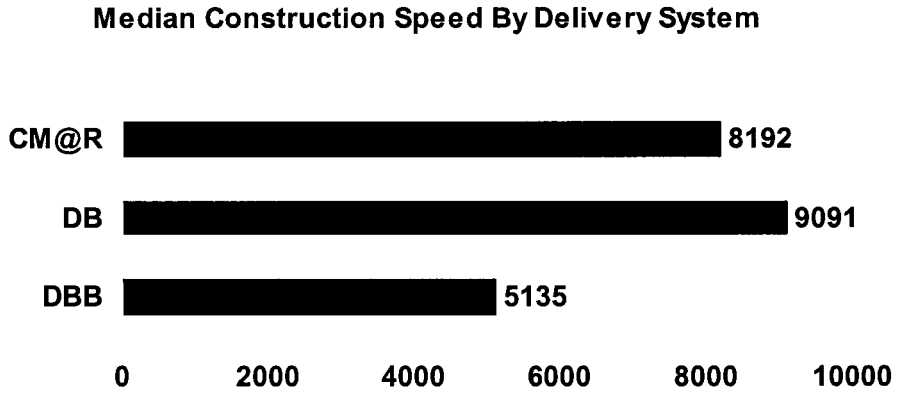


Figure 4.2: Median Construction Speed (Sq.ft/Mo.)
Source: Jeffrey L. Beard, et.al, 2001

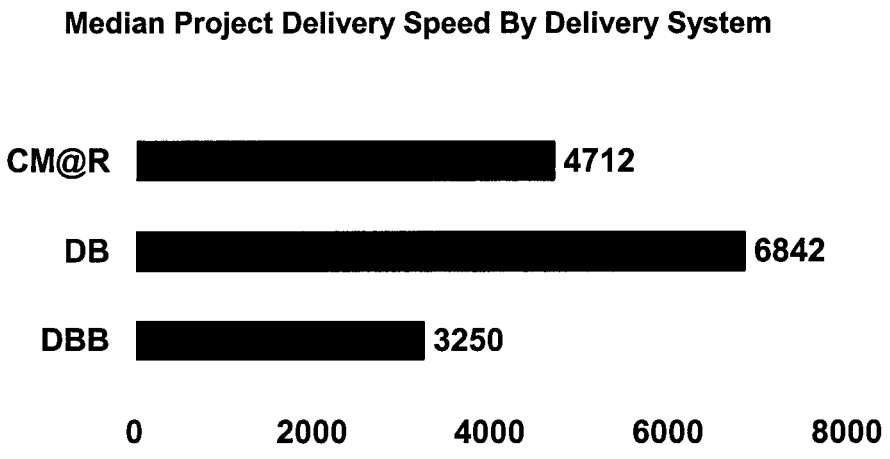


Figure 4.3: Median Project Delivery Speed (Sq.ft./Mo.)

Source: Jeffrey L. Beard, et.al, 2001

4.8.5 Cost growth Comparison

When comparing the degree of cost growth over the term of projects design and construction phases as shown in Fig: 4.4, the study found that on the average design-build projects cost grew at least 5.2 percent less than did design-bid-build projects and 12.6 percent less than did construction management at risk projects.

4.8.6 Schedule growth comparison

In a similar fashion the study compared the relative growth rates of the projects design and construction schedules. It found that design-build projects had at least 11.4 percent less schedule growth than did comparable design-bid-build projects and 2.2 percent less than did construction management a risk projects.

4.9 Responsibilities of Design-Build Project Participants

4.9.1 Owners Team

Owner's representative

As an employee of or a consultant to the owner's organization, the owner's representative is empowered to implement the project and is responsible for ensuring that the project meets the organizations objectives. It is the representative task to communicate the project objectives to their owner staff and consultants and ultimately to the design and construction industry. Conversely, representatives are also responsible for keeping the

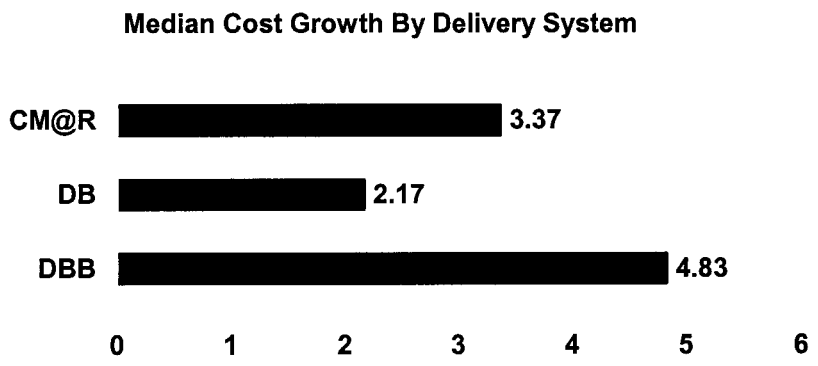


Figure 4.4: Median Cost Growth (%)

Source: Jeffrey L. Beard, et.al, 2001

Percentage of Average Difference between Project Delivery Methods by Measure

Quality Measure	D/B vs. CMR	CMR vs. D/B/B	D/B vs. D/B/B	Variation
Unit cost	7.43	7.5	5.96	.19
Construction speed	8.07	7.94	7.04	.19
Project delivery speed	6.69	7.67	6.88	.19
Cost growth	5.36	5.71	4.95	.19
Schedule growth	6.28	6.15	5.19	.19

Table 4.2 Percentage of Average Difference between project delivery methods by measure

Source: Jeffrey L. Beard, et.al, 2001

organizations decision makers informed of the progress of the project and of the significant choices or options available along the way. Finally owner's representatives must also ensure that the methodology chosen and the procurement and contract options selected are meeting the project objectives. If budgets are missed, schedules exceeded or function compromised the owners representative must make or recommend corrections to the initial procedures.

Design-Build can facilitate the active involvement of the owner in the creative process to a greater extent than can other methods. It is the responsibility of the owner's representative to take advantage of the flexibility inherent in the design-build method to charge the design and construction industry to create a product with the greatest worth to the organization. ***(Beard, et.al, 2001)***

Design criteria professional

As a representative of the owner and an intermediary between the owner and the design and construction industry, the design criteria professional is expected to address the interests of both groups. This role requires the individual to be both professional and technically qualified to translate the owner's needs into objective, quantifiable terms that can be readily understood by the industry. Likewise, the design criteria professional must appreciate the design and construction marketplace and should attempt to present or offer the proposed project to the industry in a manner likely to attract exceptional offers, namely best-value proposals. In a competitive selection process, the design criteria professional will be expected to develop the terms and conditions of the competition and to assist the owner to administer the process. ***(Beard, et.al, 2001)***

Design professional accomplishing "preliminary design"

In all project delivery methods an important function of the owner is to communicate its needs to the designers and builders in an effective manner. In a competitive Design-Build selection process the customary document used to affect this communication is the program of facility requirements or simply program. However, sometimes the narrative and tabular text of the program are inadequate to fully communicate the owner's requirements. In these instances an owner will often resort to graphic images to communicate its functional or aesthetic intent. These graphic images or drawings are referred to as bridging designs. When an owner deems it appropriate to communicate to Design-Build proposers with a bridging design, the owner will typically engage a design professional to prepare a preliminary design of the proposal.

The role of the design professional preparing the preliminary design is to assist the owner to communicate its intent to the proposers and to evaluate the technical proposals submitted in response to the RFP.During the proposal stage the design professional must be independent of the proposing design-builders. After a contract has been awarded to a design-builder the design professional may continue to assist the owner to review the design-builders design development and construction documents. Alternatively the owner could assign the design professionals contract to the design-builder for the purposes of completing the design and construction documents. In either case the owner would remain accountable to the design-builder for any errors or omissions in the bridging design. ***(Beard, et.al, 2001)***

Construction Manager

If technical capability is not available from the owner's staff then a construction management team or CM can be engaged to look after the owner's interests. This role is made much more significant in a design-build project because the normal safeguards of an architect and an engineer acting as the owners exclusive agents during the design and construction phases are absent. Task that a construction manager acting as the owner's agent could perform in a design-build project would include: ***(Beard, et.al, 2001)***

- Advising the owner on the advantages and disadvantages of various procurement procedures and design-build contract forms and provisions
- Developing the owners preliminary project budget and schedule
- Coordinating the contracts post award submittal requirements
- Developing the requirements for the design-builders critical path method (CPM) schedule and reviewing their proposal and periodic submittals
- Reviewing the proposers on-site construction management plan
- Reviewing post award design submittals for conformance with the owners design criteria and the accepted design-build proposal
- Reviewing the design-builders quality control plan
- Reviewing the periodic inspections and reports of the projects design professionals

- Coordinating the activities of independent special inspectors and reviewing their findings

- Coordinating post award scope changes and change orders

- Coordinating the activities of the owners separate contractors

- Performing general inspections and recording existing conditions and the design-builders progress

- Certifying the design-builders periodic payment request

- Coordinating the owners separate commissioning activities

- Performing final inspections

- Coordinating post occupancy performance testing and warrant claims

4.9.2 Design-Builders Team

Design-builder as team leader

The design-builder is the legal entity in privity with the owner and obligated by contract to design and construct the subject facility to the requirements of the program, performance specifications and other restrictions. The design-builder may be an individual, a partnership, a joint venture, a single firm or a corporation. The only absolute requirements to be a design-builder are to have the financial and management capabilities to accept the risk and undertake and if necessary to assign and/or subcontract the design-build task and

responsibilities. If the situation is competitive or the project tentative, it must also estimate the investment to develop a proposal and the chances of being successful. During the proposal preparations phase the design-builder will organize its team, focus the team's creative efforts and set objectives, parameters, budgets and schedules. In order to be successful at this stage the design-builder must offer more value to the owner than its competitors. If the proposal is to be negotiated with the owner rather than offered competitively the proposal must meet or exceed the owner's expectations.

On the proposal side the design-builder must provide leadership that encourages creative suggestions from all members of the design and construction team regardless of the source. Successful design-build programs are those that integrate at the conceptual design stage the entire industry from design architect through design-build subcontractors, trade subcontractors, suppliers, vendors, building systems manufacturers and craftspeople. After the award of the contract the design-builder will facilitate a broadened partnering process among the project team. Although the design-builders remaining task is to simply implement the project described in the proposal, a constant vigilance and numerous "midcourse corrections" are required to maintain quality, schedule and profitability. ***(Beard, et.al, 2001)***

Constructor as a member of the design-build team

The constructor or builder completes the other half of the design-build team. If not the design-builder or the entity in direct contract with the owner, the constructor will function as a separate subcontractor to the design-builder and will be contractually responsible for construction activities and costs alone. In practice the constructor must function as a

participating team member during all phases of the project. Except for manufacturer's representatives and salespeople most construction industry participants have little contact with designers particularly during the creative design phases. It is the responsibility of the constructor to find ways to involve industry member at the points they can add the greatest value to the project.

In the traditional design-bid-build project delivery method the constructor commences construction with a complete and detailed set of construction documents. A Design-Build constructor will likely start construction with only partial plans and specifications and must anticipate the requirements of the following construction phases. Further, the nature of a design-build contract based primarily on performance specifications is one that requires a continuous "value engineering" evaluation throughout the design phase and well into the construction phase. Instead of only attending to the means and methods of construction and accepting the design as a given and irrefutable fact, the constructor may consider other options. When a performance level cannot be achieved by the completed facility the constructor and the designer must cooperatively assess the design-builder to determine the cause and suggest appropriate remediation. ***(Beard, et.al, 2001)***

Design-build subcontractors

Subcontractors that represent building systems with significant engineering content, such as heating, ventilating and air conditioning (HVAC), structural steel fabrication and erection or building curtain wall, have an opportunity to act as specialty design-build contractors within the larger context of the general design-build contract Their role toward the design-builder is similar to those of other subcontractors, except that they are in a much better

position to contribute to the creative aspects of the design-build proposal because of their role as specialty designer. Internally, the principals of a design-build subcontracting firm must act in a fashion similar to that of the general design-build contractor; that is they must integrate the various activities of design, manufacture and installation into a mutually supportive organization whose members attempt to add value to their company's products, regardless of their individual functions within the organization-representing a true team effort. ***(Beard, et.al, 2001)***

Trade subcontractors

Trade subcontractors and their crafts employees can make meaningful contributions to the design-build process by bringing their practical field experience and suggestions to the attention of the designers during the design development stage. The design-build project delivery method is the one procedure that facilitates and encourages one end of the process, design to learn form the other end of the process, field construction. ***(Beard, et.al, 2001)***

4.10 Design-Build Process Variations

Whenever an owner decides to employ the design-build project delivery method, an important next step is to determine which variation of design-build is most appropriate for meeting the owners and the project needs. Design-build," says architect and design criteria professional Edward Wundram, "is an entire range of possibilities." Variations of design-build can be divided into two basic types, structural variations and operational variations. Structural variations are characterized by the roles of the parties within the design-build entity, including joint-venture arrangements, designer-led, contractor-led, integrated firm

and developer-led. Whereas Operational variations include direct design-build, design criteria design-build, and preliminary design design-build. ***(Beard, et.al, 2001)***

4.10.1 Structural Variations of Design-Build

Each of the five structural forms of design-build is identified by the entity that contracts directly with the owner for combined design and construction services. The five structural variations of design-build are shown in figure 4.5***(Beard, et.al, 2001)***

1. Owner and Joint venture design-builder

A joint venture is a contractual collaboration between two or more parties for the purpose of carrying out the design and construction services associated with a design-build project. The joint venture may be project-specific, or it may be organized to bind the parties for a specified period of time. Joint ventures may be formed among corporations, partnerships or sole proprietorships. Joint-venture agreements can be complex with risks and responsibilities carefully assigned to parties within the venture. The joint–venture agreement delegates responsibility for services to the individual parties; for example on a highway project the constructor may have responsibility for schedule management and control and the design engineer for quality of materials. Joint ventures does not own equipment or have employees but is merely a pass-through entity and all profits and loses are passed through to the joint-venture members. The joint venture itself does not perform services; instead it serves as a vehicle for subcontracting those responsibilities to the member parties.

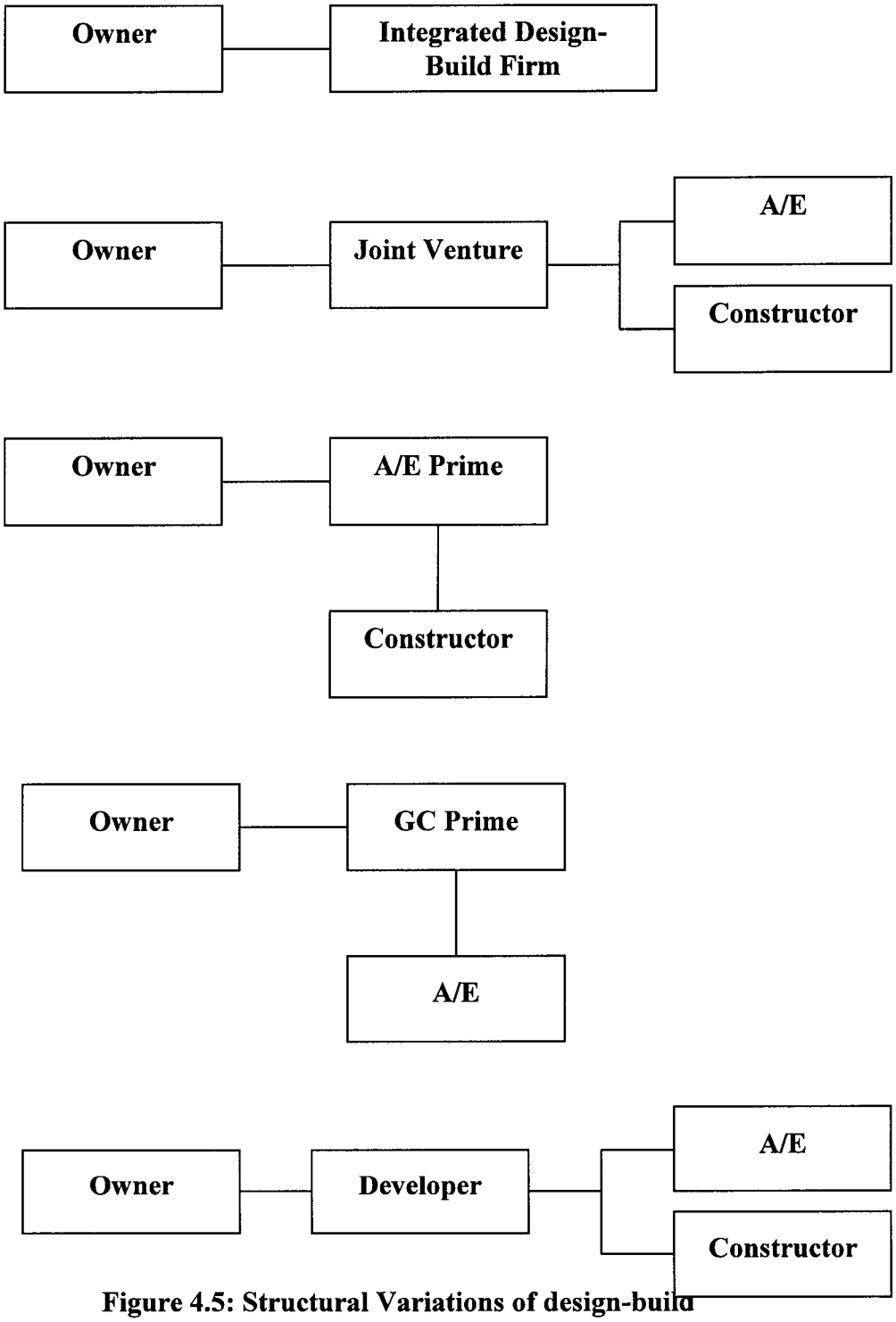


Figure 4.5: Structural Variations of design-build

Source: Jeffrey L. Beard, et.al, 2001

Favorable aspects of a joint-venture arrangement are similar to other structural forms of design-build: single source of responsibility, increased speed of delivery and lower-cost growth over the life of the project. Some owners have expressed support of the joint-venture arrangement because of the perceived ability to have simultaneous attention from both the professional designer and the constructor. Potential disadvantage of a joint venture are the liability is joint and several with each party to the venture held responsible for the other's acts. The managerial control of joint venture can be a source of disagreement among the parties for those areas where issues are of mutual concern.

2. Owner and Constructor led design-builder

The constructor led design-build entity is currently the most prevalent variation because of its ability to manage schedule and costs coupled with financial capabilities that often allow such firms to be bonded for sizable sums. Under this variation an owner contract directly with the constructor for all design and construction services necessary to fulfill the requirements for completing the project. To obtain professional design services the constructor hires a design consultant through a subcontract arrangement. The subcontract agreement descending from the constructor-led designer-build entity to the architect-engineer can take one of two forms. In the first form of arrangement, the A/E has no financial interest in the outcome of the project nor does the A/E have a financial interest in the prime design-build company. In the second form of design subcontract arrangement, the A/E has a financial interest in the outcome of the project or has partial ownership of the design-build entity itself. Among the most challenging issues for architects and engineers engaged in constructor-led design-build is the traditional A/E reluctance to take risk on

new, innovative or untried design and construction. A number of attorneys and A/E have criticized the constructor-led design-build process for its perceived loss of the independent design professional. However, this concern is mitigated because the owner may freely choose when it deems it necessary and/or is willing to pay the additional consulting fees, to hire an independent advisor. Positive aspects of constructor-led design may include an emphasis on adherence to schedule and cost goals of the owner. Constructor-led design-build may also provide for an assemblage of the best possible "virtual company" for the project with custom expertise added to the team as needed and with the party (i.e. constructor) assuming the greater part of the overall risks still in control as leader of the design-build entity.

3. Owner and Designer-led Design-builder

With designer-led design-build it is the designer that signs a design-build contract with the owner and the designer prime then engages a constructor under a subcontract. The A/E prime becomes responsible not for providing design services but also for maintaining construction cost and schedule and for overseeing the means and methods of construction. A potential disadvantage of designer-led design-build is the lack of direct communication between the owner and the constructor. This limitation places a greater emphasis on the estimating, scheduling and project control capability of the design professional. Owners expect the design-builder to have the authority to manage risks.

Beneficial aspects of designer-led design-build include a continuation of the owners trusted advisor in an expanded project role. This arrangement may encourage greater attention to aesthetic design issues and could be most appropriate for what are called foreground

structures (those structures, facilities and building where excellence in aesthetic design is the overriding objective). Satisfying clients and their needs remains a primmer goal of the design professional. Design-build is an alternate route to that satisfaction- a route that may have greater risk but at the same time offering a more comprehensive embrace of the facility development process and an opportunity for more complete relationship building along the way.

4. Owner and Integrated firm design-builder

Perhaps more than any other structural variation integrated firm design-build has tremendous potential for growth. For owners seeking true" one-stop shopping" under a single company roof this format is ideal. An integrated design-build firm truly furnishes the single source of responsibility that any owners seek. The integrated entity will provide clients with direct access to the design professional and the constructor with no apparent diminution the role or status of either. Potential disadvantages of integrated firm design-build include the challenge of having in-house personnel and resources that can provide direct experience to the needs of a given project. If the design-build project requirements are beyond the skills and capabilities of the design-builder it will need to contract with qualified designers, constructors and subcontractors outside the firm.

The greatest advantage than an integrated design-build firm can offer an owner is the ability to blend the cultures of a design firm and a construction firm into a seamless whole. The regular and close internal communication between designers and constructors can help improve delivery efficiencies through the respect and empathy that will grow amongst hardworking professionals. The integrated design-build firm will have a proven track

record of delivering design-build projects. For some owners this reassurance provides the integrated firm with an edge over the temporary alliances found under the other structural variations. Overtime, the number of integrated design-build firms is expected to grow significantly.

5. Owner and developer-led design-builder

The transition from a build-to-own developer to an independent at-risk developer-led design-build entity can be a natural one. Clients will engage the developer design-builder either as a professional agent on an hourly or cost plus fixed fee basis or as an at-risk provider of services and products on a guaranteed maximum price (GMP) or a lump sum cost basis. Developers who accept and execute combined design and construction contracts on an at-risk basis regardless of the origin of the work are design-builders. A major difference between developer-led design builders and those that are A/E or constructor led is the developer's usual lack of in-house design or construction services. Developer-led design-builders are in the advantageous position of being able to add value to the transaction such as advising the client whether it may be appropriate to acquire, lease or build facilities in specific locations or geographic areas.

An advantage of developer-led design build is the knowledge of a corporations concern about its real estate assets. Disadvantages of developer-led design-build may dissuade a corporate owner from using this structure. The spirit of true single-source responsibility can be lost under a fee-based developer.

4.10.2 Operational Variation of design-build

Most owners agree that the choice of which operational variation of design-build to employ on their project is of considerably more importance than what structural variations to employ. For some owners reaching out immediately to a total facilities provider (such as a large design-builder or EPC firm) to develop a facility program or a project study and report is the most efficient approach. Other owners prefer to work with their traditional architectural or engineering consultant to the point of concept design before engaging a design-build entity. Both ends of this spectrum are shown in these operational variations, which are shown below: ***(Beard, et.al, 2001)***

Direct design-build

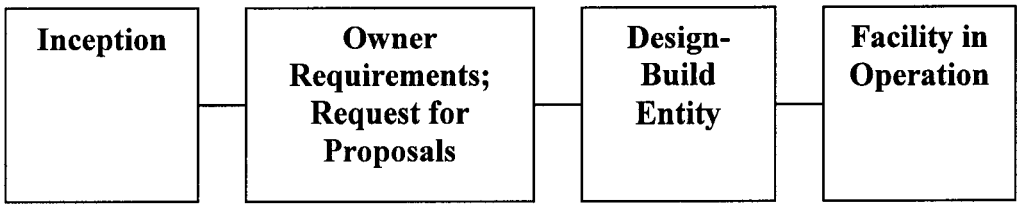
- With program and/ or pro forma developed by design-builder
- With program and /or pro forma provided by the owner

Design criteria design-build

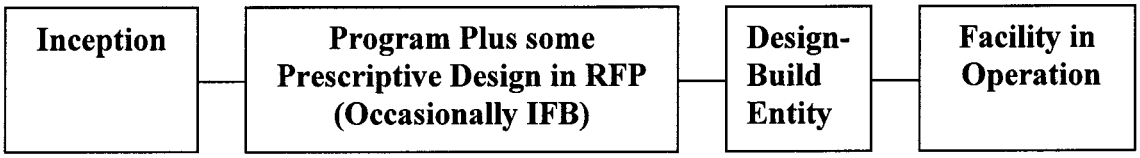
- With minimal (or nominal) design criteria and program from the owner
- With partial design criteria, program and performance goals from the owner
- With extensive design criteria, program and performance specification from owner

Direct Design-Build

Design Criteria/Design-Build



Preliminary Design/Design-Build



"Bridging" Is Neither Design-Build Nor Design-Bid-Build

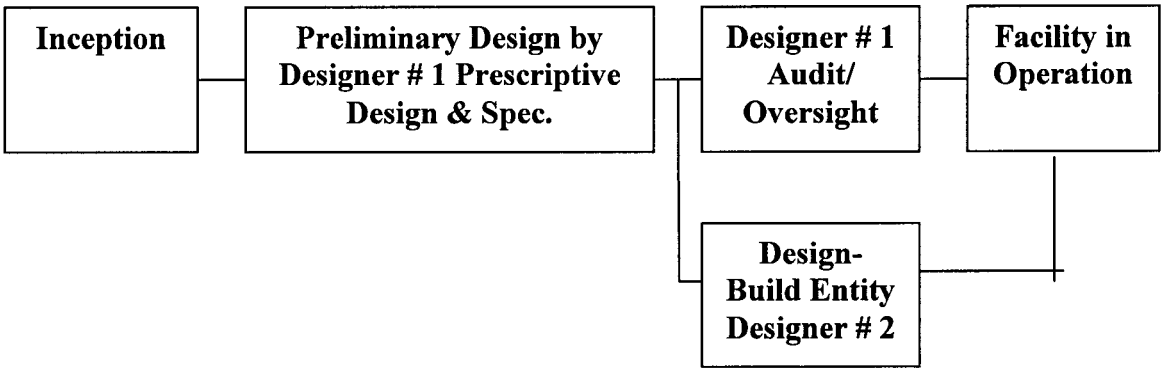


Figure 4.6: Operational variations of design-build

Source: Jeffrey L. Beard, et.al, 2001

Preliminary design design-build

- With design criteria, program, performance specification and limited single line drawings
- With conceptual design and performance-based specifications
- With owners schematic design and performance-oriented specifications

1. Direct design-build

Direct design-build allows design-build project delivery to operate in its purest and most unfettered form. Direct design-build brings the entity that is in need of design and construction services together with the provider of the services at the earliest possible time during the facilities development process. Direct design-build (with the program and/or pro forma developed by the design-builder) is an application of the growing "integrated services" concept. If the owner requires professional assistance in preparing a program (facility needs and performance goals statement), the integrated design-build firm or team can fulfill those services. Similarly, if an owner requires assistance in developing a pro forma (budget) on which to base financial planning and capital investment decisions, integrated design-build-plus teams can usually perform those estimating, return on investment costing and financial feasibility services.

Direct design-build also may be accomplished through a "call and response" iteration, in which the owner and its facilities planning staff or consultant issue a call in the form of a streamlined RFQ (request for qualifications) or RFP (request for proposals) containing the

project pro forma and program and the design-build entity responds with its submission. The call includes requirements for site acquisition, financing, maintenance and operations and other design-build-plus services. The owner chose design-build because of its ability to place those multivariate facility delivery and management needs under a single legal agreement. Creation of the pro forma and program allows the parties to build the project on paper using available assumptions and data to simulate the design, construction, use and operation and eventual sale or transfer of the facility. Design-build knowledge is extremely valuable to owners who are working through the "what to build" decisions. Determining the area, configuration, costs, revenue flow, time schedule and aesthetics or features will determine the successful outcome of the proposed project. Direct design-build will allow the owner and its designer-builder to have maximum input at the earliest stages to influence cost, quality and in word-efficiency of the facility.

2. Design criteria design-build

Many owners employ a middle-of-the-road design-build approach that has become known as design criteria design-build. The owner often assisted by professionals knowledgeable about facility planning and programming, sets out the criteria for the facility in clearly understood performance terms. In preparing the criteria package, the owner and its design criteria consultant should adhere to two basic principles:

1. Seek out and define the problems and outline the parameters for design in lieu of offering design solutions

2. Determine the minimum amount of information needed in the RFP for the offerors to prepare their project cost, bearing in mind that too much information forecloses on options available to the A/E of record

For design criteria design-build to be successful the needs of the owner must be described clearly and precisely in performance terms. The performance expectations must be communicated in a solicitation that is universally understood and interpreted by potential offerors. What design criteria design-build has the potential to do is to encourage multiple outstanding design solutions from a limited group of proposers. Further explanations of types or variations of design criteria design-build are given in the following paragraphs.

Design criteria design-build with minimal or nominal project criteria

The level of information provided under this variation is comparable to the stage of predesign and programming services as used by the A/E professions. For projects where the contract terms are based on a GMP and the owner and design-build entity have interactive negotiations to arrive at the project scope, the design criteria approach with minimal or nominal criteria is ideal.

Design criteria design-build with partial project criteria

The amount of information issued by the owner is similar to the level of "conceptual design" as used by the A/E profession. The level of "design" will likely be no more than 10 or 15 percent although it is dangerous to stipulate aggregate level-of-design percentages because they do not convey the varying level of design in each elemental package. For the proposers to establish firm fixed costs for the project, these respondents must develop

sufficient documentation beyond what is contained in the RFP in order to guarantee cost with sufficient confidence.

Design criteria design-build with extensive project criteria

The essence of this variation is clear and complete project criteria that treat the design problem in a comprehensive manner but stops short of offering design solutions. The extensive criteria is generated as a result of ascertaining all the owners' objectives for the project. Among the major objectives usually called out by the owner and its design criteria professional are functional efficiency, acceptable costs, time to complete and energy conservation. One reason why an owner may elect to include extensive project criteria in a solicitation is to obtain firm fixed-cost proposals from the marketplace. The use of extensive criteria will likely lower the amount of effort that a design-build consortium will need to expend to arrive at a lump sum cost for the project.

3. Preliminary design design-build

When employing design-build project delivery for the first time many owners and their traditional designers begin with a design-build variation that has become known as preliminary design design-build. After gaining an understanding of the concept and a realization that the full benefits of design-build cannot be obtained without allowing the A/E of record more flexibility those owners often gravitate toward design criteria or direct design-build. Preliminary design for a design-build project is accomplished by the owner or its retained design consultant to convey project information in among other things a graphic format.

The thinking behind preliminary design design-build is to have the initial architect-engineer provide the design concept and for the design-builder architect-engineer finish the design and construct the project. The process allows the owner design professional to perform in its traditional role: information gathering, programming, and early iterations of design concepts. Under the preliminary design design-build approach the owners design professional is "designer 1" for the project and the design-build entity is" designer 2" and the A/E of record. Types or variations of preliminary design design-build are:

- Preliminary design design-build with design criteria, program, performance specification and limited single line drawings

- Preliminary design design-build with conceptual design and performance-oriented specifications

- Preliminary design design-build with owner's schematic design and performance-oriented specifications

4. Delivery variation that is not Design-Build

A certain project delivery mutation attempts to position itself between design-build delivery and" traditional" design-bid-build. Under this approach the owner contracts with a design professional to prepare partial design documents. The owner issues the partially complete design documentation (30 to 80 percent) to the marketplace and request proposals. Because of the extensive design effort by the owner's designer, the system sets up the classic triad with two separate contracts: the first flowing from the owner for design and the second for design detailing and construction. Because the transfer of design with this method occurs

during design development the process does not necessarily allocate risk to the party in the best position to assume those particular risks. This method skirts the essence of true design-build, which is single source responsibility for design and construction. This process is more akin to traditional design-bid-build than design-build. ***(Beard, et.al, 2001)***

4.11 Challenges for Design-Build

There are certain challenges in the successful implementation of Design-Build method which need to be studied in detail to devise methods to overcome them. This will help in actually realizing the benefits that Design-Build had to offer. The following challenges are discussed: ***(Beard, et.al, 2001)***

Cultural barriers

- There is a concern among all the parties about gaining responsibility/liability versus giving up control
- For either the public or the industry, there is a lack of recognition of design-build as a profession or discipline
- There may be a loss of independence when working in concert with designer or constructor
- Design-build may change the designers or the constructor legal relationship with the owner

- Recognition for contributions to the project may be submerged (design, subcontracting, specialty consulting

- Fear of change; fear of the learning curve by traditional owners and practitioners

Legal barriers

- Inflexible procurement laws that do not allow purchasing of integrated services or that preclude use of other than low-first-cost-based procurement

- Licensing statutes that go beyond individual practice competency and protection of health and safety issues to affect business practices

- Building, zoning and fire code processes that are suited to traditional design-bid-build but have not been updated to accommodate performance-based standards and codes

- Permitting procedures that are based on the linear design-bid-build process and do not accommodate phased or systems-oriented project management

Educational barriers

- Schools of architecture, engineering and construction within universities and colleges are usually focused on single-discipline training; few place emphasis on cross-discipline training

- Single-discipline programs may not teach the overall process of project delivery or facility life cycle but instead concentrate on the contribution of the single discipline

- Student activity groups may perpetuate the cult of the single discipline, rather than emphasizing the need for collaborative teams

- Continuing education programs for practicing professionals are reaching only a small percentage of the industry

Technical barriers

- Most producers of product and assemblies have not changed their informational approach for design-build, that is by publishing complete performance data in accordance with up-to-date standards or showing how their products fit within systems or assemblies to meet the owner's needs

- Almost all the existing formats and classification systems do not meet the predesign needs of integrated services delivery

- Different approaches to quality and innovation are possible with design-build delivery, but A/E are unsure how to stimulate increased quality and innovation

Business barriers

- Bonding and insurance companies are still in the process of creating products for design-build; some claim that additional loss data is necessary before creating fully reliable underwriting guidelines

- Lending institution reviewing small and midsize projects may be unfamiliar with the design-build process and may require construction drawings before approval of financing

- Funding of government construction projects may hinge on approval of design before appropriation of construction monies

4.12 Design-Build Plus

Basic design-build services are characterized by the simple combination of design and construction under a single-source contract whereas Design-Build plus is the generic name for project delivery methodologies that can incorporate additional services such as business planning, feasibility studies, site acquisition, programming, finance, operation, maintenances, asset management and other deliverables to meet the market. The choice of a particular design-build plus services depends on the need for flexibility and adaptability, the presence of global competition, and the driving force for efficiency in capital economies. Different types of design-build services are discussed below: **(Beard, et.al, 2001)**

Design-Build Finance

The addition of project finance to integrated design and construction provides an enormous benefit to owners who may not have access to other than annually budgeted funds. Financing, when combined with project delivery makes sense when the projected revenues

over the economic life of the facility are adequate to meet or exceed the pro forma projections for repayments, debt service and return on investment. Design-build finance opportunities are concentrated in buildings market, water utility sector and transportation sector. A number of financing instruments are available for capital facilities from partnership equity to shares of stock and from unsecured loans to capital market instruments. Design-build finance delivery is likely to grow in the foreseeable future as a method for jump-starting worthy projects that are artificially stymied by rigid or inflexible funding sources. Design-build companies and financing companies are beginning to see the advantages of business alignments that draw on the expertise of each party.

Design-Build Operate/Maintain

The powerful combination of design and construction with operation and maintenance responsibilities is a realistic answer to owners concerns about facility quality and long-term performance. In the owners mind, the project is an asset that must perform in a satisfactory manner over time. Design-build operate/maintain is a way to incentivize the services provider to incorporate quality measures and operating vigilance that will prevent technical failure or obsolescence of the facility during the contract term. Value analysis studies have shown that there are three major areas for efficiency improvements: planning/design, construction, and maintenance and operations. The area that is least integrated into facility life-cycle models is operation/maintenance but it is the area that can have the greatest impact on life-cycle costs and improved facility value for the owner.

Program or Portfolio management

Generally program management is not considered to be a project delivery system. A program manager is normally an agent for the owner on a fee basis in the facilities delivery contacting process. An exception to the rule is when the program manager is at risk for the total amount of the design and construction cost and is required to complete the facilities delivery on a defined timetable with a required level of quality, then program manager a risk becomes a design-builder for a portfolio of owner projects. Program managers are tasked with providing extensive facilities services to their owner clients. Services at the front end of program management may include feasibility studies, site analysis, financial feasibility studies and site acquisition. After the facility is completed, the program manager may be retained to commission the facility, assist in start-up of operations, provide training to facility manager/operators or conduct ongoing management or maintenance services for the facility.

Program management is especially well suited to those projects or portfolios in which the contract is for an extended duration and the cumulative mass of the contract is larger or more complex than a traditional design-construction contract. Owners who employ program management are looking for services beyond what is traditionally provided by architects, engineers and constructors. These services may include business process analysis, planning and zoning laws, computerized value analysis and comprehensive facility management. When done on an at-risk basis, program management becomes a design-build-plus variation.

Other variations

The more popular design-build plus delivery methods currently in use include the following: ***(Beard, et.al, 2001)***

Build-operate-transfer (BOT)

This delivery method has been used worldwide in projects where the owner grants the right to build and operate a facility that will generate cash flows and profit. The facilities are typically infrastructure-related such as power plants, toll roads, water-treatment plants or ferries. At the end of the term of the operating contract, the operator agrees to turn the facility over to the owner. When using the BOT approach, the project sponsors often conclude a turnkey contract with a design-build entity. The design-builder may also be one of the project sponsors especially where the design-build entity has been providing professional services since site inception of the project and is tying part of its future economic fortune to the BOT project.

Build-own-operate-transfer (BOOT)

In addition to the permission to operate a project for a period of years, the BOOT Variation enables the design-build-plus consortium to have ownership the property during the operating period. Development rights may provide opportunities to maximize returns for investors and equity participants. A BOOT agreement incentivize by taking advantage of business opportunities available through the facility and its user base.

Build-Own-Operate (BOO)

The BOO arrangement incorporates the financing, designing, constructing and operating of a facility but without the requirement for transferring full ownership over to the owner at the end of the agreement term. Some governments do not sanction any BOO arrangements because much of the control over the services that the facility provides is ceded to the consortium. On the other hand, a BOO is attractive to the sponsors since it allows syndication or public offering of stock in the venture.

Lease-sale-transfer variations (LST)

Innovative delivery methods occasionally incorporate leasehold rights that may be granted to the developer, to the investors, to the owner or to the design-build team. The design-build-operate team may begin the project with ownership rights allowing the project to attract favorable financing and rates. After a stipulated period of time, the facility ownership rights transfer to the owner, who leases the facility back to the team for operation. The concept also may be applied by private owners who issue long-term property rights to developers and/or financial consortia, where the owner retains the right to lease portion of the completed facility for their corporate use. The owner benefits by acquiring needed facilities without huge investments and can therefore place capital at work for their core business or in other more liquid investment vehicles. **(Beard, et.al, 2001).**

CHAPTER 5

DEVELOPMENT OF DESIGN BUILD MODEL

5.1 Development of Model

Design-Build Project delivery method is being used extensively for the procurement of public, institutional and corporate facilities. Design-Build method is considerably different from the traditional Design-Bid-Build, method normally employed by the project owners and participants. Design-Build method offers flexibility to owners in response to their urgent needs. To take full advantage of the design-build process each request for qualifications (RFQs) and request for proposals (RFPs) should be prepared to fit the owner's unique situation. An invariable prerequisite of design-build competition is that the owner's needs must be described precisely and in a manner that will be universally understood and interpreted. This then, requires an efficient model for implementing design-build method. This chapter describes the procedural framework that the various participants can use for the effective implementation of Design-Build method. The approach for model development in shown in figure 5.1

DEVELOPMENT OF MODEL

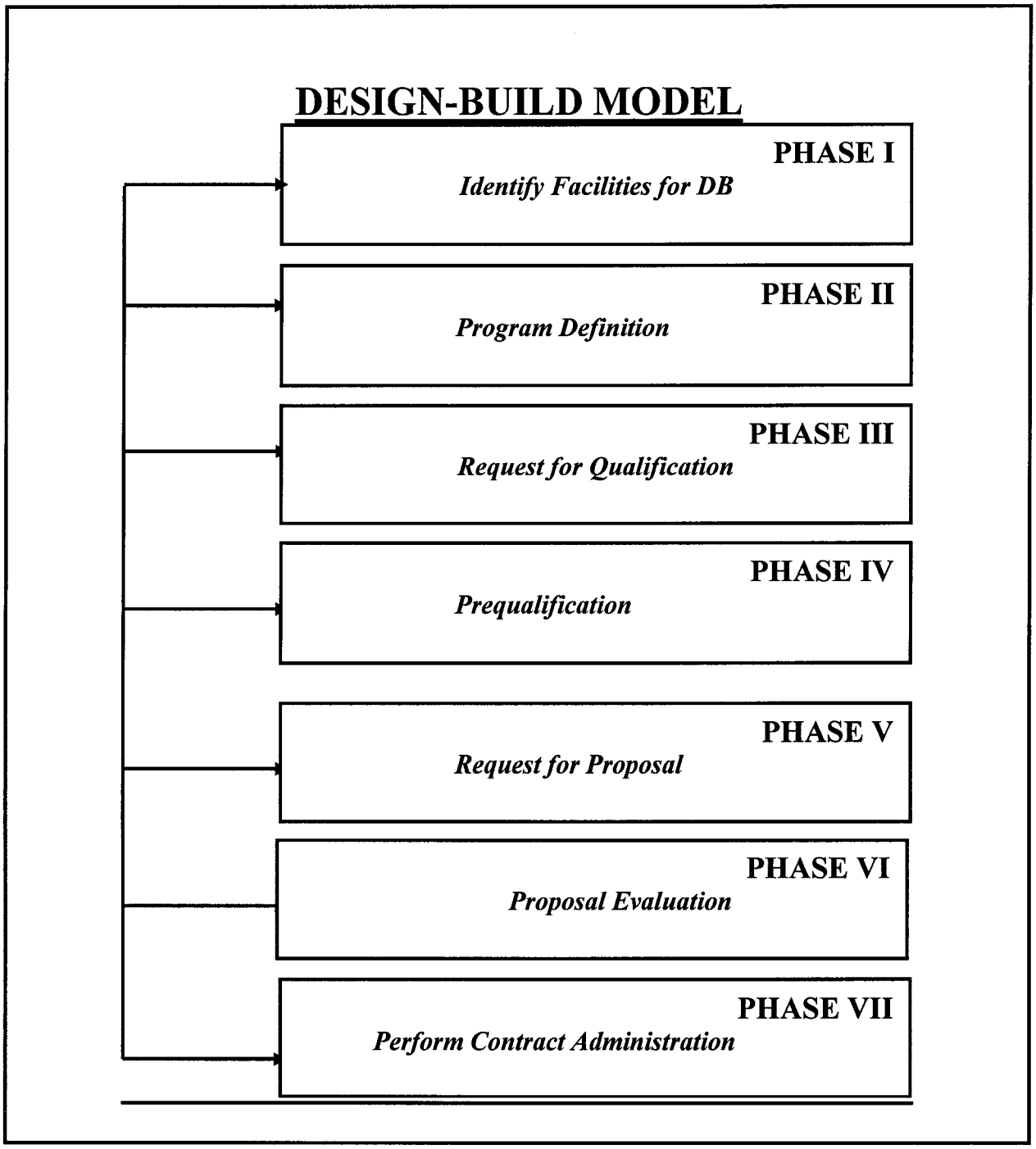


Figure 5.1: Design-Build Model

5.2 Model Description

The purpose of the model is

- To assist owners and project participants in the effective implementation of Design-Build Method
- To discuss the various elements of competitive Design-Build method, information to be provided to the proposers, and specific facts and technical data to be submitted to the owner for the proposals to be evaluated and considered for award of contract

The model suggests a methodology to be adopted throughout the various stages of Design-Build method. The model is divided into 7 distinct phases. In phase I facilities for effective implementation of Design-Build method are identified based on project characteristics, owner requirements, applicable market sectors and previously constructed /designed facilities.

In phase II "program definition", the complete program is defined based on owner needs, budget, site conditions, schedule, staff, and the facility's functions. Phase III consists of RFQ (request for qualification), a formal request for the necessary and desirable qualifications from design-builders followed by Phase IV the prequalification of the design builders.

In Phase V a formal RFP (request for proposal) is issued to the prequalified design builders and Phase VI deals with the evaluation process of identifying the proposal most advantageous and providing the greatest value to the owner. Phase VII of the DB process includes management activities required to ensure proper implementation of the contract.

5.3 Phase I: Identification of Facilities for Design-Build

The first phase "Identification of Facilities for Design-Build" includes activities required to be determine if Design-Build is an appropriate contracting strategy for a particular project. Identifying and analyzing project characteristics, owner requirements, applicable market sectors, previous constructed design facilities are some of the principle steps in determining whether Design-Build is a conducive. Limited, uncertain information is available in the early stages of project development. However, available project information must be analyzed to identify general building requirements. Facilities identification phase is represented in Figure 5.2

Project Characteristics:

Determining project characteristics provides input into determining if the project is a candidate for a Design-Build delivery approach. Determining the project characteristics includes those sub-activities that characterize the specific project as a potential DB project. These sub activities and their associated decisions determine if the nature of the project is conducive for conducting a DB approach. Below is the explanation of major sub activities in Project Characteristics for applying DB approach.

a) Project Type

If the project must be designed by professionals and has to be constructed by experienced builders, it is a valid candidate for the design-build project delivery method. Almost anything in the built environment can utilize the design-build methodology to advantage.

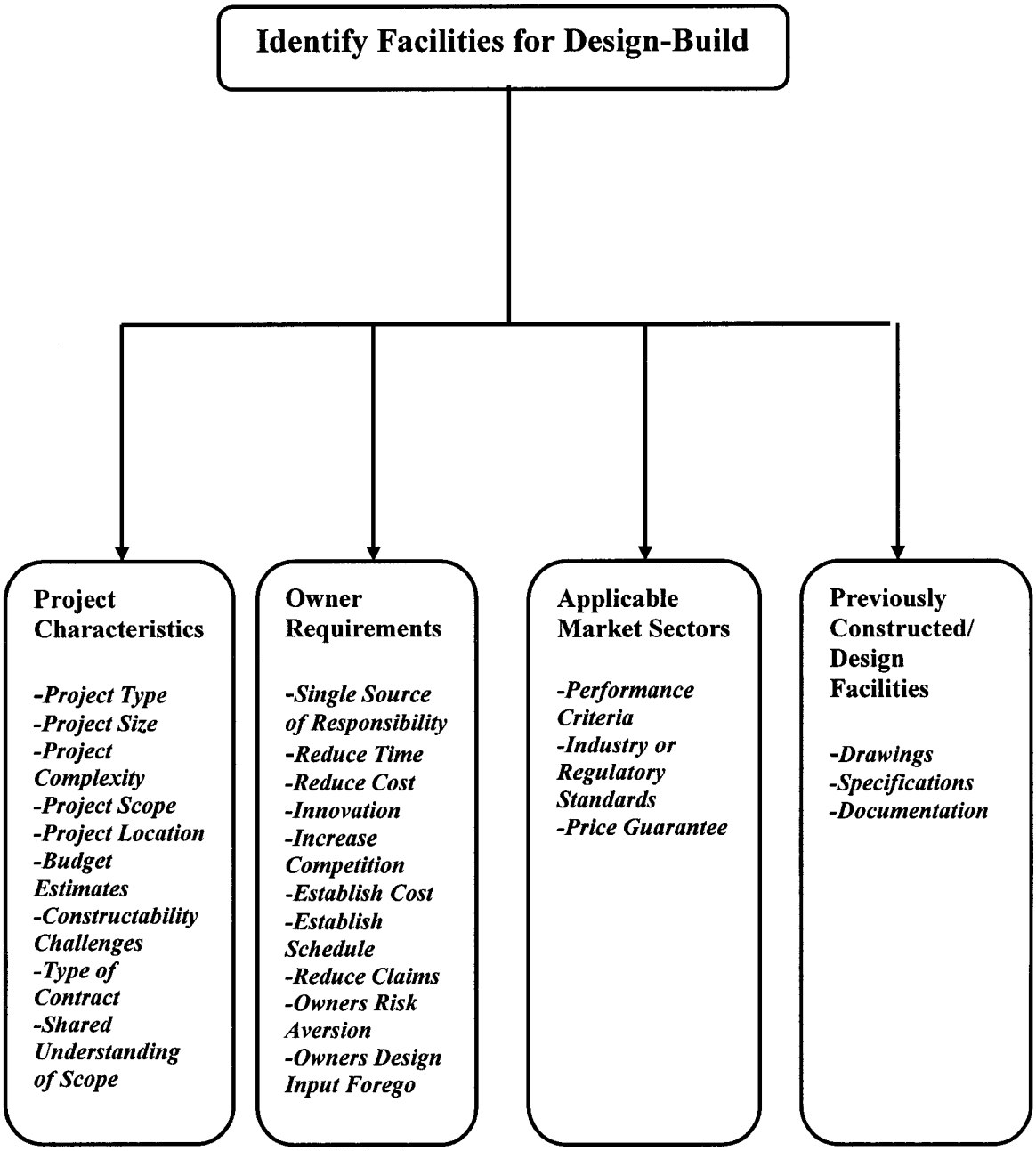


Figure 5.2: Phase 1: Identify Facilities for Design-Build

b) Project Size

Project size is one of the first measures that will be examined in Design-Build analysis. The size of the project must be large enough to warrant the proposer's risk to obtain the contract. If the project is too small, it will not justify the expenses to prepare a design-build proposal. If the project is too large, it may exceed the capabilities of the design-builders. Through joint ventures and subcontracting arrangements, design-builders can devise contracting organizations that can adequately accept the risk of very large contracts. Typically, the very large project like power-generating plants, paper plants, nuclear power plants, and complex chemical processing plants and refineries have always been the purview of the design-builder because the risk of separating the responsibility for design from that of construction is too great for the owners of these large facilities.

c) Project Complexity

Project complexity may be the reason for an owner to select Design-Build method. State-of-the-art research facilities, manufacturing plants with new production technology and other high technology buildings where the facility needs are constantly evolving require new and untried building design solutions that are clearly experimental. Also, dealing with one entity reduces administration and managerial burden on large and complex construction for the owner. Hence, Design-Build contracting method can be effectively employed in these situations if contract clauses for compensation recognize the need to keep the design decisions fluid as long as possible. There is often a misconception that very complex facilities are not suitable candidates for competitive design-build environment. This is not true. Within the design and construction industry, teams of

designers, specialty consultants, builders, and design-build subcontractors specialize in very specific and often complex facility types. But the key is the ability of the owners and their consultants to clearly define the project programs and performance requirements in objective terms.

d) Project Scope

In order to utilize the design-build contract method, owners must clearly characterize their needs and provide considerable technical detail as to their resources, including program, budget, site conditions, schedule, staff and the facility's functions. The owner must have a precise understanding of the project scope before it is submitted to the design-build team. It also includes space requirements, architectural aspects, site design from a planning and arranging perspective, dimensional and volumetric requirements, acoustic and environmental requirements. Definition and understanding of project scope is the most important element for design-build project success.

e) Project Location

Difficult construction circumstances such as radically accelerated construction schedules, remote or unusual project sites, extreme weather conditions, labor or material shortages and the need to keep the owners critical functions in operation during construction can be present in any type of project. Design that effectively mitigates these factors can be devised only with the, "meaningful participation" of the builder. Projects that are often subject to these challenges include airports, hospitals, facilities in remote areas, facilities

in areas of rapid population growth, computer and telecommunication facilities, and high-tech and other manufacturing facilities in rapidly changing markets

f) Budget Estimates

The entity responsible for design is simultaneously estimating construction costs and can accurately conceptualize the completed project at an early stage in design development, guaranteed construction cost proposals can be delivered sooner than is otherwise possible. This permits early establishment of financing and reduced exposure to cost escalation.

g) Constructability Challenges

Inherent in Design-Build process is the early involvement of contractor. Applying contractor's knowledge early into the design fosters creative design and construction solutions. Design and construction personnel, who are working and communicating as a unit, can evaluate alternatives, choosing systems, methods, and materials that enhance the project. Hence, if used correctly design-build promotes constructability.

h) Type of Contract

The successful implementation of Design-Build depends on whether the project is being awarded as lump sum, unit price, cost-plus, guaranteed maximum price, fixed fee or other. Unit price and guaranteed maximum pricing in Design-Build contracts are two methods that permit competition among proposes, while allowing the program and the designs to evolve right up until the time of construction of the specific building systems.

i) Shared Understanding of Scope

A project characteristic favoring the use of Design-Build is the shared understanding of scope by project participants. The owner and design-builder should share a clear understanding of functional and technical performance required in the finished project.

Owner Requirements:

a) Single Source of Responsibility

Design-Build offers a single point of responsibility. This help owner to have more control over the designer in achieving more positive results of their objectives. Many risks associated with facilities acquisition are transferred to the single entity or design-builder. With both design and construction in the hands of one entity, there is a single point of responsibility for coordination, quality, cost control, and schedule adherence, which avoids others for errors and shortcomings. Owners are able to avoid the role of referee between designers and builders and can focus on needs and scope definitions and timely decision making.

b) Reduce Time

Design-Build helps in reducing time compare to other project delivery methods. Communication is greatly improved when design and construction are under one contract. Because design and construction can be overlapped, and because general contract bidding periods and redesign time are eliminated, total design and construction time can be significantly reduced. This results in reduced design and construction time

and encourages fast tracking. The time savings translate into lower costs and earlier utilization of the completed facility.

c) Reduce Cost

Design-Build ability in reducing the project duration and also the involvement of the contractor knowledge early in the design process helps in reducing the overall cost of the project. Hence owner willing to reduce the cost of the project may adopt Design-Build contracting strategy.

d) Innovation

Design-Build elicits creative responses from the project teams. Normally, the ability to innovate in design and construction is severely curtailed by the use of prescriptive specifications. With Design-Build performance requirements are stated and the design-builder(s) may use different solutions to meet the owner's ultimate project goals. Hence, owner may use Design-Build to encourage innovation and obtained the proposal that provides most value for money spend.

e) Increase Competition

Owner willing to increase the competitive nature of the project will opt for Design-Build method. After the owner outlines its needs in the RFP, it will receive different design solutions and cost proposals representing the best thinking of several design-builders (team of architects, engineers, contractors and specialty consultants). These alternatives designs will enable the owner to better weigh the risks and benefits of several competing

proposals before committing to any single design solution. By giving credit in the evaluation and award mechanism for design excellence, materials and systems quality, function efficiency of the plan, the design and construction teams experience and other intangible factors beyond price, an owner can select a proposal that offers the greatest benefit, and not simply the lowest first cost.

f) Establish Cost

An owner who wants to secure a fixed cost for his project would select Design-Build method. Since one entity is in control of design, scope, budget there is less opportunity for scope related change orders. Also improved relations among A/E's and contractors reduce liability issues associated with increased project costs. A clear scope coupled with continuous interaction with the client from preliminary budget value through completion of the contract is essential.

g) Establish Schedule

As owners choose Design-Build to establish cost, they may or will also use it to establish schedule. Majority of the schedule problems in traditional method such as design errors, design omissions etc arise due to communication problems between A/E's and contractors. By allocating responsibility to one entity this problems can be minimized.

h) Reduce Claims

In Design-Build process design errors and omissions are solely the responsibility of the design-builder, which protects the owner from liabilities issues. Claims for errors or

omissions or for time delays tend to disappear, because the design-build team would have no one to blame for these shortcomings but itself. Design-Build may not completely remove litigation problems in the construction industry but helps in promoting non-adversarial relationship between designer and builder.

i) Owners Risk Aversion

The owner willing to shift some of the traditional risks such as design errors and omissions to the design-builder would like to obtained his facility using Design-Build project delivery method.

Applicable Market Sectors

a) Performance Criteria

If the owner needs can be expressed in objective performance terms that are readily understood by the industry, and the results can be accurately measured by unbiased testing procedures, the project delivery method allows the design-builder broad opportunity to design cost-effective solutions. Building types that fall readily into this category are power-producing facilities, water and wastewater treatment plants, food processing plants etc.

b) Industry or Regulatory Standards

Civil infrastructure projects described by detailed, technical and state standards are excellent candidates for design-build procurement procedures. Design solutions for similar building types will vary considerably, but the program elements will all meet

common standards for size, function, proximity, performance and the strength and durability of materials.

c) Price Guarantee

Institutions financing design and construction of a project require cost guarantees from the owner before significant funds are released. Guaranteed project costs can be known much earlier in the design-build process. The same entity that is responsible for the design is at the same time conducting cost estimates as the design evolves, providing accurate costs for the completed project while the design is only at the conceptual stage. An effective design-build procurement program will balance the need for the owner to have wide latitude in design choices, with the requirement of the design-builder to control design details after its design proposal has been selected.

Previously Constructed Design Facilities

Documentation, drawings, specifications that exists from similar, previously constructed facilities is a good source of information to determine if the facility is a candidate for a Design-Build project delivery approach. Valuable information can be ascertained from both the successes and failures of previously constructed facilities.

5.4 Phase II: Program Definition

Unlike traditional design-bid-build procurement method, which asks the simple and direct question "What will my building cost?" design-build proposals respond to the more complex and difficult request "Show me the best facility with the greatest value that meets my needs and budget." Thus we see that needs define responses, and responses define the design-build contract. In order to utilize the design-build contract method, owners must clearly characterize their needs.

An invariable prerequisite of design-build competitions is that the owner's needs must be described precisely, and in a manner that will be universally understood and interpreted. This aspect of design-build requires the owner's staff to conduct adequate research and investigations to determine the facility requirements, and to document them unambiguously. The necessity to determine needs in advance contrasts sharply with the traditional project delivery process where needs may be loosely defined to the designer.

In program definition as shown in Fig 5.3 the owner establishes the project "needs" of functional areas, their occupancy (staff and visitors), equipment to be furnished or accommodated (with utility information), the indoor environment, standards for each

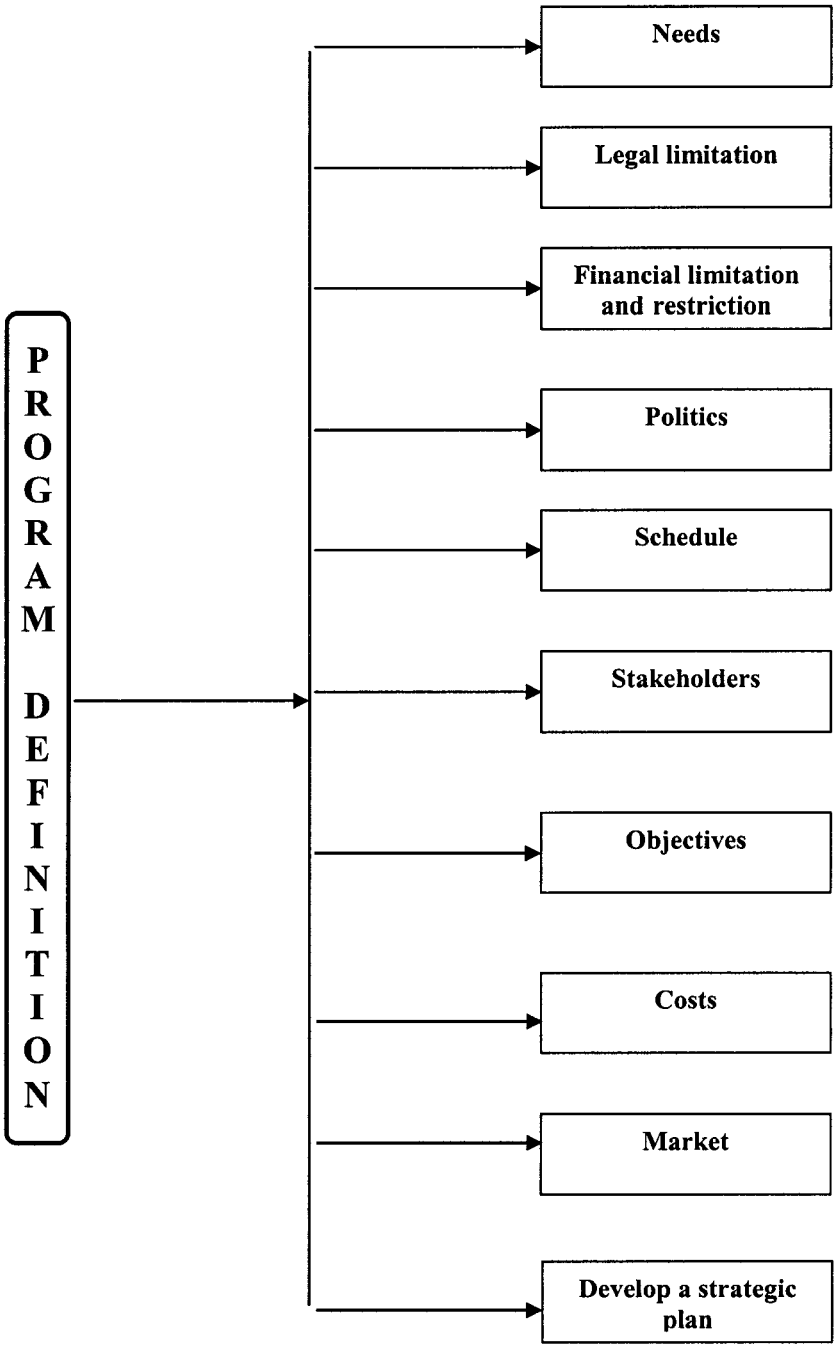


Figure 5.3: Phase 2: Program Definition

area, relative locations within the facility, materials, finishes special conditions, and applicable codes and regulatory conditions.

Owner Needs

Program narrative

This consists of a completely subjective discussion of the image that the owner wants the new facility to portray to the employees, public and others. The specific design goals are meant to reinforce the broader issues of image, character and so on.

Mission statement

The owner or its criteria professional must develop descriptions of the organizations functional units and indicate how they carry out their work from day to day. This includes how the units interact with the public and the type, number and frequency of all visitors. Needed also is a description of all materials arriving and departing including paperwork, and the unit's end product whether is a physical object or an intellectual property.

Staffing

In addition to the existing and projected workforce requirements of each unit, this section must include a description of each individual's positions job function, including any special equipment or furniture necessary to perform the jobs tasks.

Area requirements

Determine the net usable floor area for each workplace and support facility and summarize the total net area requirements. Wherever possible, reduce the number of different-sized workstations or office spaces to as few as possible to ensure greater flexibility of the completed facility to accommodate organizational changes in the future, without extensive physical changes.

Physical and Environmental requirements

Determine the physical and environmental requirements such as temperature, light, humidity, air-changes etc for each workplace and type of facility support space including equipment requirements. Also include a general description of the surrounding finishes like hard, soft, waterproof, special etc and the acoustical environment required.

Relationships

Functional relationship among all programmed spaces in the facility to each other can be indicated graphically in a "bubble diagram" or in a proximity matrix with weighted values shown. Alternately, the program document can simply describe the critical adjacency relationships and those that may be desirable but not mandatory.

Legal Limitations

Public contracts law

Does Design-Build procurement require specific legislative authority or is it allowed as one of several project delivery methods available. Consulting the appropriate legal

authority for specifics on exactly how to structure the RFQ and RFP to comply with the applicable public contract laws should be a part of program definition.

Professional licensing

Do the state and local professional laws apply to design-build procurement? Design-build competitions for significant public facilities often attract design professionals from a wide geographic range. It is important to communicate the requirement that it is the design-builders responsibility to meet all the requirements of the states professional licensing laws in the design and construction of the facility.

Contractor prequalification

Is contractor prequalification allowed and if so, under what conditions? The preparation of a design-build proposal will require an extensive amount of work by all members of the design-build team. To be fair to those teams participating and to encourage the maximum competitive effort, the number of prequalified finalists should be limited to three and not more the five. For complex project the number of proposers should be limited to smaller number. Projects for simple, well-understood types of facilities, reasonably larger number of finalists may be allowed to participate.

Honoraria

Can a public agency pay for goods and services not received, that is, proposals not accepted? If allowed by law, it is strongly recommend that honoraria be offered to the unsuccessful proposers. The honorarium or stipend serves several purposes: (1) the

provision of reasonable compensation will encourage the more sought-after Design-Build teams to apply and, if short listed, to make an extra effort in the preparation of their proposal; and (2) the provision of an honorarium will tend to diffuse the potential for criticism from the unsuccessful teams that they "did all that work for nothing". The amount of the honorarium should be proportional to the complexity of the facility, the submission requirements, the time allowed to prepare the proposal and other considerations.

Financial Limitations and Restrictions

Funding in place

Is the project funding in place. It is necessary for the owner that the funds for the design and construction are in place or that funds reasonably can be expected to be available by the time it is necessary to execute a contract with the successful design-builder. Design-build team should be convinced that the owner has or will have the funds to proceed should they be successful in their bid.

Funding limitations

What funding limitations are contained in bond issues or in enabling legislation? Often bond issues and/or enabling legislation providing for the authorization and funding of major public projects contains specific language related to the size, site, or other aspects of the proposed project. It is important to include the specific language of such qualifications in the RFP.

Politics

Local professionals and builders

If the application of the design-build procurement process is new in your area, some members of the design and construction will be wary of it. To attract the best-qualified designers and builders to the project, you will need to know their concerns and objections to the process. Many of those concerns can be addressed in the structure of the RFQ and RFP and in the published selection criteria. It is important to show that the owner is sensitive to their concerns, while maintaining the advantages the design-build process offers.

Political rationale

Learn the political rationale or motivation to initiate the project. Learn the background for the decision to proceed with the project and incorporate the rationale into the structure of the RFQ and RFP and into the design criteria as appropriate.

Schedule

Time is essential in most, if not all, design and construction contracts. The amount of time available for team organization, preparation of qualification statements and design-build proposals and the schedule necessary to design and construct the facility, is critical for those contemplating participation in the selection process. Because the time allotted to the various tasks in the selection process and in the subsequent design-build contract can be adjusted reasonably to balance this resource, the critical date is the owners' absolute beneficial deadline. Once established, all other activities likely can be scheduled to fit

within the elapsed time allocated. The degree to which the activities are compressed or can be generously scheduled will influence both overall cost and the markets response to the RFQ/RFP.

Stakeholders

Official chain of command

Know and communicate to the proposers the official chain of command from the owner's project manager up to the board of the appropriate governing authority. The design-builders will want to know, even before submitting their qualification statement, who decides the major issues in the selection process, but more importantly who decides on the final award.

Community and business leaders

Most large public projects have a series of interest groups and individuals who promoted the project or who have an extraordinary interest in its successful completion. It may be wise to keep those groups and individuals informed of the projects progress and to keep those same groups and individuals involved in the project in some way.

Design review committee or planning commission

There are boards, committees or authorities who must review the design-build selection procedure and the RFP design criteria prior to its publication. To avoid conflicts with such boards, committees or authorities, they must not be advertently or inadvertently bypassed.

Users

Know the facility users. If the facility is to house an existing organization, there should be some means for representatives of the employees to provide comment on the facility program, as it may affect their working conditions.

Unions and other industry groups

Review the design-builder prequalification process and selection criteria with the executive boards, or with the business agents of, the applicable building Trade unions, contractor associations, and professional societies. If possible, address their concerns in the RFQ.

Objectives

Image and Appearance

Subjective qualities of a facility's design program are difficult to define and put into words. However, the degree to which a design-build proposal is able to meet such design criteria for image and character are often the deciding factor in many design-build competitions. Interview all major stakeholders individually to arrive at a majority consensus on "what the facility should look like" or "what it should not look like".

Functional Efficiency

Functional efficiency is the ability of the facility to perform its day-to-day tasks efficiently, and the adequacy of the design to facilitate convenient and secure circulation of both people and materials. To the degree that this efficiency can be measure and

standards established, they should be stated in the building program and quantified in the selection criteria.

Health and Safety

For almost every type of facility there are issues of public and employee health and safety, from pedestrian security in a parking garage, to indoor air quality. Those issues of health and safety that go beyond the requirements of the applicable building codes must be assessed and specified in the RFP.

Value for money

All public procurement must stand the test of value received for money spent. This "value" is often a measure of the usable floor area, quality and durability of materials and systems, and the facility's operating costs. It is the obligations of the owner, in a design-build competition, to inform the design-builder as to how and by whom these criteria will be evaluated and the relative priority of each in the selection process.

Local labor content

All other factors being equal, most public agencies would like to encourage local participation in the design and construction of their facility, at all levels. It may even be the foremost reason for the initiation of the project. If the local labor content, of both design professionals and building trades, is to be a consideration in the selection, it must be listed in the selection criteria.

Cost

Reasonable cost to design and construct a project

Prior to the publication of the RFP, the owner must be confident that the facility program and performance specifications can be met for the fixed lump sum proposal amount or within the owners maximum allowable proposal amount, If the owners expectations exceed the reality of the design and construction marketplace, the level of competition will be reduced significantly, and the likelihood of receiving design-build proposals with significant exceptions either to quality or to quantity will be almost certain, In the first instance, the most qualified teams of design-builders will not apply for the project if they perceive that the request is unrealistic. In the second instance, a qualified proposal may not be legally acceptable or is certain to be challenged by the unsuccessful proposers.

Contingencies

It is important to illustrate to the design-builder that the contingency and other costs of a project have been budgeted and financed. This gives the proposer the confidence that reasonable changes to the contract can be funded and that the owner will not attempt to make the design-builder absorb the costs for such changes. This confidence will translate to a more competitive attitude on the part of the proposers.

Market Conditions

Qualified and interested design-build teams

Before developing a strategic plan for the procurement of design-build proposals, it is important to know the number of qualified design-build teams in the area and their

interest in responding to a design-build RFP.To attract a sufficient number of qualified teams; one may need to go outside the area for one or more of the required disciplines. Sometimes, announcement of the owners "intent to request design-build proposal" will get enough responses o determine the level of interest and the skill available in the region.

Attract design-build teams

Review with the individuals and firms responding to the "intent" advertisement, either a draft of the RFP, or an outline of the design-build procurement process. Be sure to include all responding firms in any communications or invitations to briefing or informational meetings. Consolidate the responses and consider the inclusion of all suggestion not likely to diminish the quality of the design-build proposals or that do not put the owner at any additional risk for design integrity, cost exposure or schedule completion.

Develop a strategic plan

From the data and other necessary information assembled, develop a plan of action that appears most likely o produce the results described in the owners list of goals and objectives. Review the plan with legal advisers, procurement specialists and others who may have experience with the design-build selection process. This is the creative pat of design-build program management and probably its most critical element. . It is not necessary to write out the strategic plan, but it is important to communicate the essential elements of your plan to those in the decision matrix and to get their concurrence. This

concurrence is particularly necessary from those responsible to develop or approve the selection criteria and from those individuals who will be accountable for the technical and design evaluations.

5.5 Phase III: Request for Qualification

The RFQ is a formal request for the necessary and desirable qualifications from design-builders wishing to be considered for the competitive proposal preparation phase of the selection process. But just as important, it is the initial document in a strategic plan to "sell" the project to the most qualified teams of designers and builders.

Request for qualification

In a best-value or similar competitive selection process where price is not the sole criterion, the proposers will not simply respond with a price "bid" as they do in the traditional design-bid-build process, but will compete on a combination of important factors such as experience, talent, past performance, resources, design, construction and management skills. Later they will compete on the basis of design innovation and excellence, value-added to the project and responsiveness to the owner's objectives including cost. The project outline is the owner's first opportunity to attract the targeted design-builders and to encourage them to assemble teams that can offer the subjective attributes the owner's needs for the design and construction of a successful facility. Following information should be furnished in a formal Request for Qualification (RFQ) as shown in Fig 5.4.

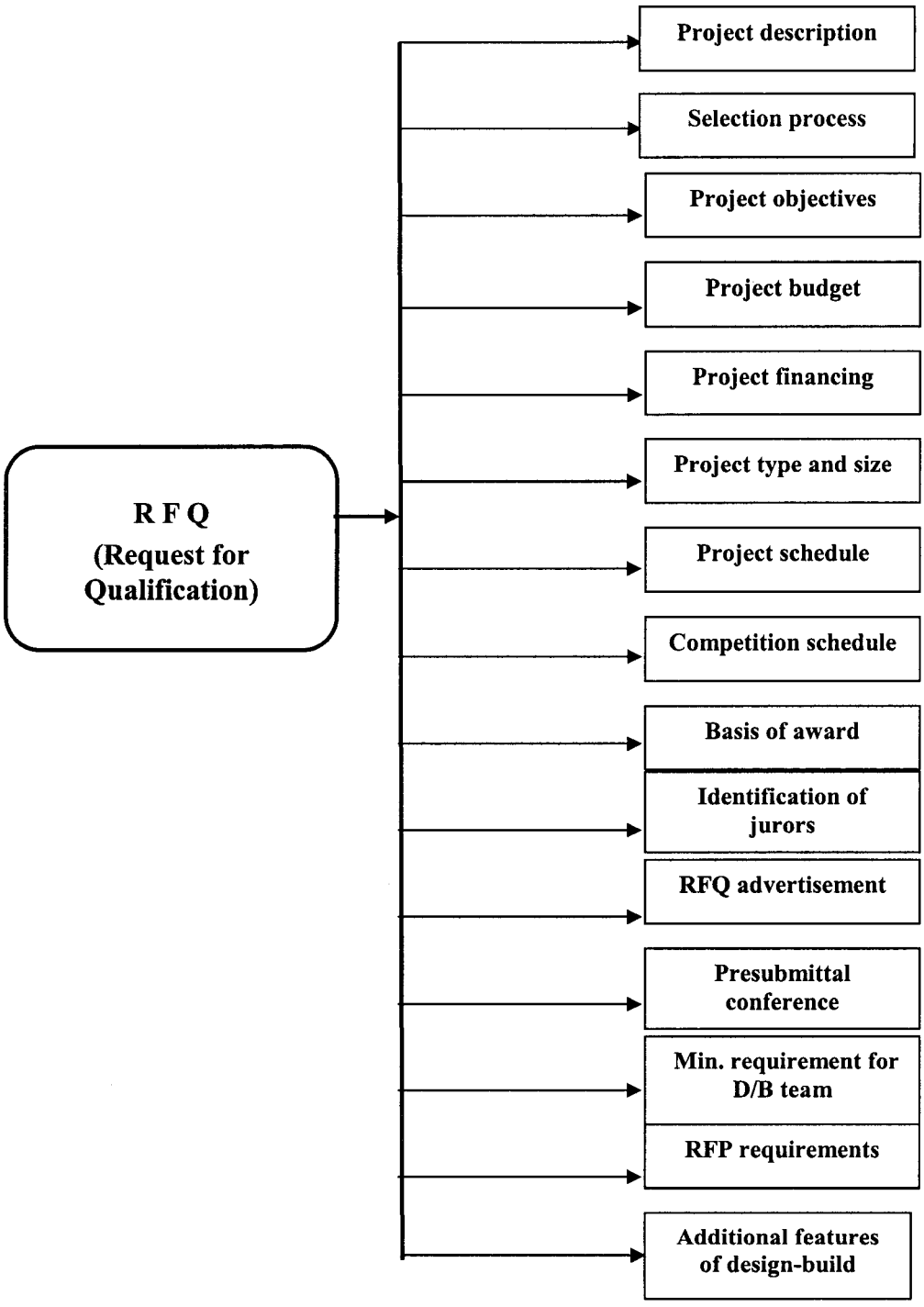


Figure 5.4: Phase 3: RFQ

1. Summary project description

The summary of project description should contain these descriptive elements.

- Owner, including organizational components to occupy or use the facility.
- Net or gross floor are and number of stories, if known
- Site location and site area
- Estimated construction start and completion dates
- Services necessary such as design, construction, demolition, renovation etc.

2. Summary of Selection Process

A short description of selection process is mentioned. It should include the following:

- Owners contact person, name, title, address, phone numbers, and the restrictions or limitations on direct communications
- Deadline for submission of design-builders qualification statement and number of copies required
- The maximum number of finalists the owner intends to invite to participate in the next phase of the selection process.
- Compensation to be offered to the finalists for the preparation of design-build proposals.

3. Project Objectives

Summary of the owners project objectives, in general order of importance. That will give the prospective design-build applicants an indication of the owner's values and some

guidance in the assembly of the design-build team. The objectives, at this point may be the simple comprehensive qualities the owner seeks for its facility.

Examples include

- Design excellence, character and image
- Functional efficiency, safety and security
- Quality of systems and materials
- Operating and maintenance costs and energy efficiency
- Elapsed time to design and construct
- Capital cost or value

4. Project budget

A summary of the project budget will indicate to the design-builders the relative value of the design and construction to the entire project. a simple analysis of the project budget and the project scope will indicate to the design-builder whether the competition will be a "budget challenge", or if there will be sufficient funds to allow design flexibility and materials and system quality improvements over and above a code-minimum facility. The results of such an analysis will likely figure heavily in the design-builders team composition decisions.

5. Project Financing

The most pertinent piece of information a design builder will seek when analyzing its decision to submit its qualifications is the progress of the projects financing. Nothing is a greater disincentive to a prospective design-builder than the understanding that the

project funding is somehow in doubt. It is to the owner's advantage to delay the call for qualifications until the projects financing is reasonably secure. In some instances when occupancy and completion dates are critical, owners will proceed with the RFQ phase, with the expectation that the projects funding will be assured before commencement of the RFP phase.

6. Project type and size

Similar to the summary project budget, the building area summary will help the prospective design-builders analyze the projects design challenge. A one page summary of the floor area requirements will indicate to the design-builder whether the owner has been realistic in allocating space for specific functions and for supporting areas such as circulation, mechanical and electrical areas. This analysis will help define the design and budget challenges inherent in the project. This same information also allows the prospective design-builders at their own risk to get an early start on the development of a design concept and a pricing strategy, well before prequalification.

7. Project Schedule

All contracts must state a time period in which the services and/or product are to be delivered and the RFQ is the first place to give the proposers the owners specific needs in this regard. In those instances where the completion date is critical, the RFP must include a "but not later than "qualifier in the project schedule. The RFQ should summarize the project schedule for the prospective design-builder respondents.

8. Competition Schedule

The competition or RFP schedule is the schedule of the entire selection process and should include all activities from initial announcement to notice of award. The schedule should be stated in specific calendar dates and it should clearly identify the time allotted for the preparation of qualification statements and for design-build proposals. Owners should consider carefully any changes to the competition schedule after it has been initially published. Unexplained changes to the schedule may make the design-build teams suspicious that other r changes may also be contemplated.

9. Basis of award

Prequalification

The owner's decision process for selecting the most qualified design- builders is the most critical aspect of the design-build prequalification process. The owners must establish requirements to measure and determine the most qualified firms to invite to participate in the proposal preparation phase. Only firms that have been qualified by the owner may submit a proposal and the owner may select a proposal only from a prequalified firm.

Complete proposal

A valid and complete design-build proposal meeting all the requirements of the RFP must be submitted. Proposals with limitations or conditions are subject to disqualification and rejection.

Functional facility

Proposals must provide for a complete and functional facility. In the absence of any description of function in the RFP, the owner has the right to expect the proposal to provide for a facility that will be fully operational in every significant aspect and for the purposes for which the facility was intended. Award will be made on the evidence and on an unqualified assumption that the proposal provides a completely functional facility.

10. Identification of Jurors

The identification of the jurors will greatly influence the composition of the design-build team. Potential design-build applicants should be notified in advance that the jury alone would make the recommendation to the owner of the winning design-build proposal. The owner may also limit its authority to accepting or rejecting the jury's recommendation. The jury may not select any proposal other than that recommended by the jury but may reject the recommendation and start over with any other legal selection process.

11. RFQ Advertisement

The official announcement of the project should be placed in the "legal announcement" newspapers serving the agency's jurisdiction. Additional legal advertisements should be placed in other areas from which the owner expects to draw design-build proposers. If the owner has targeted national or international design and construction firms then display advertisements in national and international publication may be warranted which requires longer lead times and greater expense than the normal legal announcements. Interested

parties then can be send the request for design-build qualifications and competition prospectus document (RFQ).

12. Presubmittal conference

For significant projects where there is considerable interest or where the submission requirements are complicated, the owner should schedule one or more presubmission meetings not later than 2 weeks prior to the deadline for submission of the qualification statements. The meeting allows the owner's staff and consultants to answer potential proposer's questions in person, to "sell" the project and to gauge the level of interest among the targeted design and construction firms.

13. Minimum requirement for D/B team

The minimum requirements for consideration for prequalification should be as objective as possible. These may include

- Design and/or construction experience in the facility type and scope
- Minimum experience of design –builder in design-build method of contracting
- Minimum level of bonding capacity
- Minimum insurance requirements
- Limitations on the geographic location of the design-builder
- Minimum design team composition
- Minimum DBE participation on the design team
- Required license, registration of design-builder and team members

14. Summary of RFP requirements

The design-builders that intend to submit qualification statements in response to the owners RFQ should be informed in advance of he requirements of the RFP.This allows he design-builder the opportunity to assemble its team of designers and other subcontractors with an understanding of each team members responsibilities, task, schedule and submittals required by the RFP.

The RFQ should forewarn the prospective design-builders of the following:

- Agreement to prepare a priced design-build proposal
- Competition schedule
- Requirements for owner's briefings
- Questions and answers and other communication restriction
- Submittal requirements
- Fixed or variable price and alternates required or allowed
- Technical evaluation of proposals and selection criteria
- Request for clarifications of proposals process
- Public exhibition of models and display boards
- Requirements for in-person presentations
- Jury recommendation
- Contract award
- Final report of jury

15. Additional features of design-build

- Requirements for professional and contractor licensing
- Other restrictions
- Proposal bond requirement
- Contract bond including design
- Liquidated damages
- DBE contracting and similar requirements
- Quality control plan
- Responsibility for hazardous materials on site
- Owner furnished information
- Code
- Permits
- Training requirements for owner's staff
- Required construction drawing format(CAD)
- Retainage
- Dispute resolution
- Requirement to use firms listed in design-builders qualification statement

5.6 Phase IV: Prequalification

The owner's decision process for selecting the most qualified design-builders is the most critical aspect of the design-build prequalification process. The ability of the design-builder to successfully complete project efficiently and on time is a key attribute that an owner must consider when evaluating prospective design-build proposers. Design and

construction management capabilities vary from one organization to another. While most firms are inherently eager to compete for different types and sizes of projects, some firms are better are qualified in terms of management skills, design quality, quality control, finance, experience and personnel than other firms for a specific type and size of project. For this reason, minimum requirements combined with a screening process using published and weighted evaluation criteria are essential. Collectively those requirements and judging factors are referred to as prequalification selection criteria as shown in Fig: 5.5.

Prequalification Selection criteria

1. Design-builders organization and management plan

It is important that the organizational structure of each applicant organization be identified clearly for the specific project for which it is applying. With this information the jury can determine, at least relatively which organizations have the greatest potential for meeting the owner's objectives and delivering the project successfully and efficiently. The selection criteria therefore should be structured to require the applicant demonstrate that its proposed organization-management plan has the capability, special experience and the technical competence to deliver the proposed facility within the schedule, quality level and other existent and/or specified conditions.

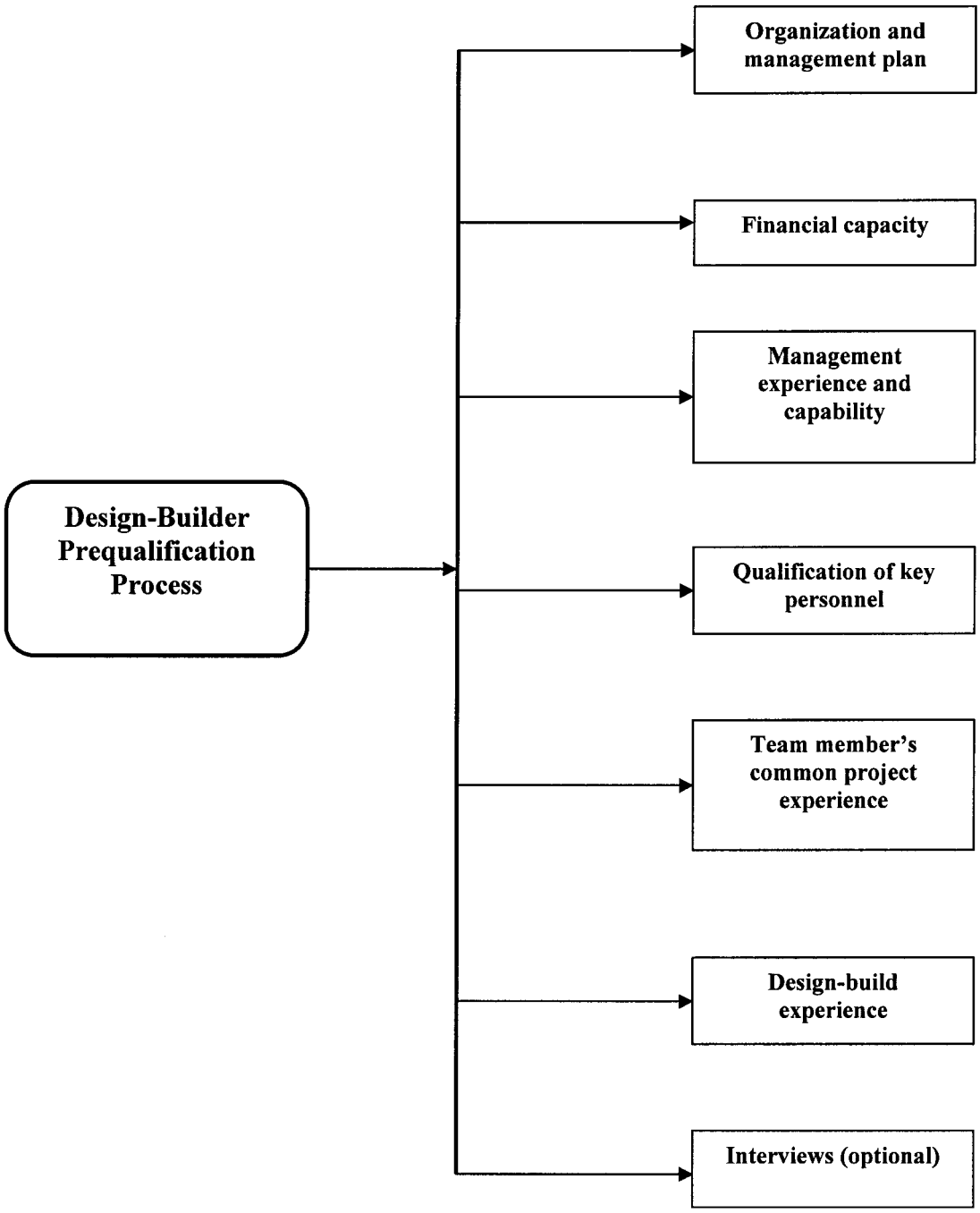


Figure 5.5: Phase 4: Design-Builder Prequalification

2. Design-builders financial capacity

The successful proposer must have the financial capacity to absorb the project start-up costs and to maintain the day-to-day working financial aspects of the organizational structure. The submission requirements should require applicants to identify project financial arrangements, proof of ability to bond the contract, their current situation with regard to significant claims and/or lawsuits pending or outstanding judgments of any significant size and an indication of their financial reputation among the applicable business, banking and credit institutions.

3. Design-builders management experience and capability

Design-build projects with their combined design and construction responsibilities must be carefully and prudently managed to meet both the owners and the design-builders goals. Strong project team leadership capabilities and relevant management experience for both the design and the construction sequences are essential selection criteria.

4. Design-builders construction experience

Design-build applicants should be asked to demonstrate the level of construction experience and competence of the proposed team members and their ability and willingness to partner with the owner, designers and others to meet their collective objectives.

5. Architects and engineers design experience

Whether the owner receives a well-designed and functional facility is greatly dependent on the team's architectural and engineering capabilities. Broad knowledge and experience in such important areas as aesthetics, client communications, facility programming, urban and site planning, environmental design considerations, design of building systems and interiors, materials, equipments, color selection and cost and schedule control is essential. Demonstrated excellence in some or all of those areas should be required for prequalification.

6. Qualification of key personnel

Essential to all projects are the specific key personnel forming the design-build team for the project. Regardless of past achievements of an organization, its ability to respond successfully on future work is dependent on the specific capabilities of key personnel assigned to the project. The RFQ should require that those applying for prequalification must identify key personnel and provide short resumes to demonstrate the specific knowledge, experience, and capability of the individual to perform in the assigned role. Applicants must be reminded that after prequalification, significant changes in the composition of the design-build team member firms, personnel, roles or responsibilities may not be made without the prior written approval of the owner.

7. Team member's common project experience

The ability of a project team to work together effectively and in harmony is essential for a design-build team where most participants share a common goal. Owners should look for

evidence of such favorable common experience among the key member firms and/or individuals either on another design-build project or on a project of similar scope and complexity.

8. Design-Build experience

For the owners of most large public projects, design-build procurement is a new or recent experience and consequently a relatively new experience for those local or regional firs that seek and perform design and construction for such projects. Familiarity with the process, risks, responsibilities and types of participants is a valuable asset for a design-build team.

9. Interviews (optional)

Purpose of interviews

The intent of these optional in-person interviews between the design-builder and the jury is to enable the jurors to further evaluate the capabilities and qualities of the design-builder and its design team, to distinguish between seemingly equals, and reduce the list of finalists to a prescribed number.

Typical areas of inquiry by the jury include

- Design-build team relationships and previous experience
- Methods used by the team members to design a facility within budget
- Techniques for conflict resolution within the design-build team
- Scheme for team leadership and management

- Project analysis
- Quality control philosophy and implementation during design and construction

5.7 Phase V: Request for Proposal

This phase includes developing and administering the project request for proposal. RFP is the primary communication tool for conveying the owner's goals and objectives to the design-builder. The RFP contains instructions and descriptions of the procurement procedures, standard contract forms and data, price proposal forms and schedules, description of project conditions and site date, project specifications, design guidance and evaluation criteria and procedures. RFP should remain as open as reasonable towards design. This allows creativity from proposal responses. Specification for Design-Build proposal must be developed as performance specification combined with prescriptive specifications that allow the construction industry the opportunity to propose a variety of design and technical solutions yet insure required quality levels are maintained. The information to be provided in the RFP is shown in Fig 5.6.

1. Identification of owner, consultants, jury and design-build teams

On the cover page the body issuing the RFP and requesting design-build proposal is listed. All officials in the chain of command relative to the project and RFP are indicated. Each prequalified design-build entity and its member firms, architects, engineers and specialty consultants are listed with complete address. All members of the owner appointed jury and their organizations and positions are listed. If the jury is to be assisted

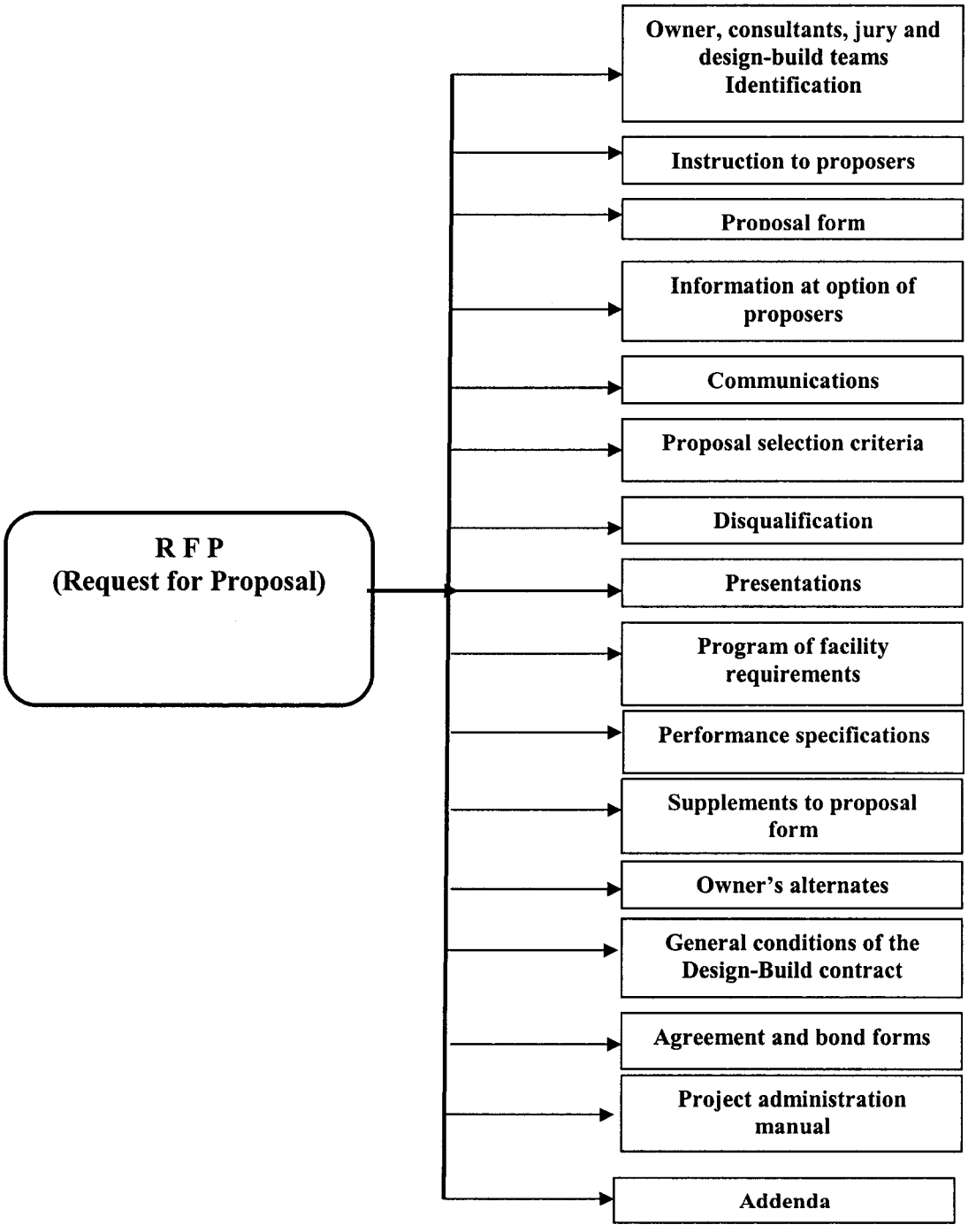


Figure 5.6: Phase 5: RFP

by a panel of advisers or consultants responsible for the technical evaluation of the submitted design-build proposals, their names, titles and organizations are listed.

2. Instruction to proposers

Definition and terms: The RFP with attachments of the RFQ should include a definition of the names and terms used in the various documents. A single list of definitions be included in the RFP and indicate that it applies to all contract documents unless specifically indicated otherwise.

Eligibility to receive RFP and submit a design-build proposal

Only those prequalified design-builders listed in the title pages of the RFP are entitled to receive the RFP and addenda and only they may submit a design-build proposal. Each design-build entity must remain exactly as indicated in the design-builders qualification statement and duties and responsibilities of the prequalified design-build team members may not be significantly changed without the owner's permission.

Competition Schedule

The competition schedule lists all the critical dates in the competitive selection process, from initial advertisement for qualifications to the scheduled date of the announcement of award. In other sections, if it is necessary to refer to a date, it should be done by reference, for example, "by the date indicated in the competition schedule". If it is every necessary to change any date in the competition schedule, this is the only section to be amended.

Information provided to proposers

The owner is obligated to provide the finalists with all pertinent information that conceivably may be useful to the proposers, to avoid the possibility that some significant information may be available to some, but not to others. The owner is obligated to provide the finalists with information concerning the physical, environmental and legal conditions relative to the site and its surroundings. It is in the owners interest to reduce the design-builders risk by providing or obtaining as much information as possible about the owners needs and constraints.

3. Proposal Form

In addition to the normal provisions of an owners proposal form, the following modifications may apply to a design-build proposal form:

- Proposal amount fixed in advance owner and printed on the form included as an attachment to the RFP
- If the proposal amount is capped, include this phrase after the blank for the base proposal amount: "which amount shall be equal to or less than $XXX
- The proposer must certify and warrant in the proposal form that its proposal meets or exceeds every requirement of the RFP, including but not limited to the program of facility requirements and the performance specifications.
- However, if deviations and exceptions are allowed the proposer must list and reference each and every deviation from the requirements of the RFP that are contained in its proposal.

- Proposer must attach list of documents and other exhibits that constitute its complete proposal.

4. Information at option of proposers

General

To stay competitive, some proposers may feel that they have to prepare and submit substantially more technical and design information than the minimum requirements. As a general rule, the RFP should request only enough information to be able to evaluate the proposals and to have sufficient particulars to describe the facility.

Additional technical information

It may be appropriate to allow the proposers to submit additional technical drawings, specifications, calculations and special reports. This additional information can serve to protect the interests of both parties to the design-build contract by describing more precisely what is offered in response to the RFP.

Additional professional resources

Although there are provisions in the RFP and in contract to prevent unauthorized substitutions on the design-build team, the design builder must have the liberty to add those professional capabilities it feels in necessary to satisfy the responsibilities inherent in its design proposal.

Unsolicited alternates

It is common for a design-build team, in the course of preparing its proposal to discover alternatives to its design that technically violate the requirements or limitations of the budget, schedule, program and/or performance specifications; but it may add value to the facility. The design-build selection process however must be based strictly on the proposers' responses to the RFP and its requirements. Therefore, the jury must not consider any unsolicited alternates until at least a preliminary evaluation and scoring of the base proposals has been completed.

5. Communications

It is in the owner's best interest to maintain a high level of competition among the finalists. This can be achieved by maintaining an unbiased method of communications among finalists and owner

The following procedures improve communication and create an atmosphere of impartiality:

- Develop a comprehensive and detailed program and performance specification that anticipates the proposers questions
- Conduct a thorough in-person briefing for the design-build teams
- Conduct multiple question-answer sessions for the finalists in joint meetings then publish the Q& As in addenda to the RFP.
- Establish cutoff date for questions and a deadline for last addenda to RFP atleast 2 weeks prior to submission deadline.

6. Proposal Selection criteria

Beyond the mandatory requirements of the program and performance specifications, the "proposal selection criteria" is probably the most critically examined section in the RFP.Thus it is important for the owner and its project staff, jurors and consultants to make every effort to define and summarize those criteria, achieve a consensus among those responsible for evaluation and selection and present the criteria in a meaningful way.

Criteria: The criteria may be subjective or objective. Proposals are evaluated against selected RFP requirements. They represent the most important features of the specific project being evaluated. These are the features of the project that must be evaluated for conformance prior to a construction contract award. They may include cost or value as a criterion. The number of criteria cited should be kept to an absolute minimum. Typically, the range is from 5 to 10 separate criteria. In either case, the criteria must be weighted in some manner to indicate the relative importance of the specific selection factor to the owner. Also, prequalification criteria should not be used along with proposal selection

7. Disqualification

The owners criteria professional or other third-party, program administrator must be given the responsibility and the authority to monitor the proposal preparation phase, the proposal submissions, and the evaluation phase to ensure equality to all and complete compliance with the RFP requirements and restrictions by all proposers. If significant and intentional breeches of the RFP procedures occur, the consultant must investigate and

recommend corrective actions, including proposer disqualification, if warranted. If unintentional or unlisted discrepancies appear in the proposals, the consultant must require the proposer to certify that the proposal will meet every requirement of the RFP or disqualify the proposal. The basis for disqualification, at each phase of the selection process should be described in the RFP.

8. Presentations

For design-build competitions in which subjective design criteria is the predominant factor in selection, the design-build proposer must be given sufficient opportunity to present and defend its proposal before the evaluators and jury. The primary methods of communicating the proposal are the narrative and graphical materials attached to the proposal form and submitted in response to the RFP.A third and highly effective method of communication is the in-person presentation of the design-build proposal to the owner, its evaluators and its jury. This type of presentation allows the jurors the opportunity to hear firsthand from the designers and possibly to understand the derivation of the design and the rationale for the form, character, image, and so on. It also allows the jury a chance to ask introspective questions of the design-build team just prior to the jury's final deliberations.

9. Program of Facility Requirements

The program of facility requirements and the accompanying performance specifications are the owner's detailed and specific expressions of needs. As primary contract documents, they describe the end product to be produced and delivered by the design-

builder. The owner is cautioned to prepare these documents with considerable thought and attention. Once a design-build proposal has been made, it is difficult to make significant changes to those requirements. All subsequent cost-related changes have to be made by a prescribed change-order proposal and acceptance process, generally without the benefit of competitive pricing. The component parts of a program of facility requirements are

- Program narrative discussing the image, character, and broad design goals of the proposed facility
- Mission statements of the functional units expected to occupy or use the facility
- Staffing patterns and summary job descriptions for each workplace to be housed in the facility
- Net area requirements of each workplace and support facility
- Physical and environmental requirements of each type of programmed area
- Internal and interoffice relationship diagrams
- Sketches to communicate specific arrangements of rooms or of components within specific rooms

10. Performance specifications

The preparation of project specifications for a DB project varies considerably from a traditional design-bid-build project. The specifications must allow the construction industry the opportunity to propose a variety of design and technical solutions yet insure required quality levels are maintained. Project specifications for a DB project are therefore developed as performance-oriented specifications. These, combined with

perspective specifications, are the most critical element of the RFP.The premise for developing project specifications is "Offer as much opportunity as possible". Therefore, performance specifications need to be used as much as possible to allow for maximum flexibility and innovation. If an item is not in the RFP, the Design-builder will not include it in the proposal. Therefore, coverage of the RFP must be complete and address all necessary elements. This does not mean that the RFP be restrictive or over specific.

For each building system (structure, roof, exterior closure, ceiling lighting systems, HVAC, etc) the owner must specify the minimum performance expected at occupancy and the applicable industry standard desired. The Construction Specifications Institute a uniform classification of construction systems and assemblies is recommended for the development of the performance specifications. To the extent possible, the owner should avoid design or system selection decisions of any type unless it is necessary for technical coordination with the owners other physical plant systems or integration into existing maintenance and repair procedures.

Prescriptive specification has the effect of removing design responsibility for the specific building system from the design-builder and placing it with the owner. This act contravenes the basic premise of design-build: a single point of responsibility for design and construction. If necessary to designate minimum quality levels desired by the owner, some materials, building systems or subsystems specifically can be excluded in the performance specifications.

Performance standards and attributes: Within each category or building trade industry standards are the most common reference for establishing performance standards. Some of the industry standards organizations typically referenced are

- American Society of Testing and Materials (ASTM)
- Underwriters Laboratories, Inc. (UL)
- Canadian Standards Association (CSA)
- Federal Specifications (FS)
- National Fire Protection Association (NFPA)
- Illuminating Engineering Society (IES)
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

Trade and manufacturing associations also can provide generic standards and data oriented to specific building systems, equipment, products and materials.

Section format for performance specifications

Part 1. Performance

A. Basic Function

B. Areas of Concern

1. Amenity and Comfort

- Performance requirement
- Criterion for measurement
- Means of substantiation

2. Health and Safety

- Performance requirement
- Criterion for measurement
- Means of substantiation

3. Structure

- Performance requirement
- Criterion for measurement
- Means of substantiation

4. Durability

- Performance requirement
- Criterion for measurement
- Means of substantiation

5. Operations and Maintenance

- Performance requirement
- Criterion for measurement
- Means of substantiation

Part 2. Products and Assemblies

Part 3. Methods of Design and Construction

11. Supplements to proposal form

Supplements to the proposal form are the proposal bonds, required certificates (if any) and the exhibits describing the design-builders offer to the owner. Those exhibits describe the specific facility offered by the design-builder in response to the RFP.The RFP must

indicate the minimum submittal requirements and may also include a limitation on the number, size and type of submittals that will be allowed. For drawings, display boards and models indicate scale, size and any limitations on graphical technique such as " all drawings must be black line on white background" or " perspective drawings may be in color or back and white, at the proposes option.

Appropriate level of detail

The level of detail needed to require in the submittal documents should be determined by the owner and specified in the RFP.The specifics required for each design discipline and each building or facility system will depend on the complexity and uniqueness of the project, the capabilities of the finalists, the amount of the honorarium, the time allowed and the amount of detail necessary for evaluation and contract security. For most design-build selection procedures, a level of detail equivalent to a complete schematic design would be sufficient. Often proposers will submit exhibits that exceed the minimum levels of detail required in the RFP.In fairness to all proposers, unlimited technical submittals should be discouraged or disallowed.

12. Owners Alternates

The use of owner's alternatives in a design-build proposal is discouraged. It puts the design-build team preparing the proposal in the uncomfortable position to determine if it is better to make the base proposal more attractive or the alternate lower-priced. Alternate diffuse the focus of the design-build competition and create confusion in the minds of the evaluators and jurors. An option to owners alternates would be a prioritized list of desired

but not required facility attributes in the RFP that the proposer may chose to include within the base proposal price and its proposal would be evaluated accordingly on a predetermined basis.

13. General Conditions of the design-build Contract

In addition to the normal provisions of the general conditions of contract, an owner must consider for addition or modification, as they may apply to the design-build procurement process.

Design-builders proposal

Proposal must be defined in the general conditions to include the design-builders submitted proposal and any preaward clarifications thereto.

Design and construction documents

When accepted and approved by the owner for progress, the design development and construction document (plans, specifications, shop drawings and equipment cutsheets) produced by the design-builder after award become a part of the contract documents. But the owner's approval and acceptance of those documents do not relieve the design-builder from the obligation to meet the requirements of the RFP and its proposal, unless specifically indicated otherwise by the owner.

Permits and fees

The design-builder may be responsible to apply, pay for and qualify for all construction and occupancy permits required to the applicable agencies. The owner must agree to cooperate with the design-builder in this regard.

Project coordination

Include provisions to submit design and construction documents for approval by the owner at various stages and define the stages and the level of documentation required.

Insurance

It is seldom necessary to require professional liability insurance certificates from the architectural and engineering firms associated with the design-builder, because the owner does not have direct contract with those firms and is relying on the design-builder to meet the design criteria. Consequently, the design-builder will be responsible for covering any claims arising from design.

Responsibilities of the design-builder

Design-builders responsibility to provide all services (including design), labor, materials and equipment and the management necessary to achieve the intent of the RFP should be defined.

Design-builders architect-engineer

Define the design-builders architect-engineer to encompass the entire design team, namely all professional architectural, engineering and specialty consultants required to design the facility and produce the necessary design and construction documents. The design-builders architect-engineer should be the same in-house staff listed in the design-builders qualification statement, unless the owner has approved a change. The design-builders architect-engineer should at all times attempt to safeguard the health, safety and well being of the public regardless of any instructions from the design-builder to the contrary.

The design-builders architect-engineer should inspect the work periodically and reject that work that does not comply with the construction documents prepared and/or approved by it. The design-builders architect-engineer should make interpretations of its construction documents when requested to do so by the owner, which interpretations shall be reasonably inferred from those documents. The design-builders architect-engineer should review and approve all shop drawings, samples and other items for compliance with the construction documents and the intent of the RFP, prior to their submission to the owner.

14. Agreement and Bond Forms

Agreement Form

A copy of the form of agreement between the owner and the design-builder must be included as an attachment to the RFP.It should include, by listing and on execution by attaching the RFQ, the design-builders proposal and supplements, requests for

clarifications issued by the owner, design-builders clarifications, contract bond and certifications, corporate board resolutions or other submittals required by the RFP.

Proposal Bond

Some owners forgo the requirement for a bid bond on fixed-price proposals, even though the honorarium is likely to be considerably less than normal bid bond. Proposal bonds however should be required for any type of variable-price design-build proposal.

Contract Bond

The form of contract bond form must specify that the bond shall secure the design-builders faithful performance of the entire contract, including any and all professional design services necessary to complete the contract. Separate bonds or construction-only bonds, must not be allowed to secure a design-build contract.

15. Project Administration manual

The project administration and manual describes the procedures to be followed by both the design-builder and the owner's representative during the term of the design-build contract. It will include

- Directory of project principals and their official contact
- List of fixed events described in the RFP
- List of the design-builders notice requirements, as specified in the RFP
- List of the design-builders submittal requirements, as specified in the RFP
- List of the owners fixed notice or response requirements, as specified in the RFP

- Correspondence procedures between the design-builder and the owner's representative
- Schedule of regular and special meetings and procedures for minutes
- List of records required of both design-builder and owners representative
- Forms to be used by the design-builder

16. Addenda

In addition to the normal and anticipated changes in an RFP document, the addenda should contain proposer's questions and the owners corresponding answers. Those questions may have been submitted in writing or asked in person by a design-build team member at any one of several preproposal meetings conducted by the criteria professional. The design-builder must be able to rely on the accuracy of those answers as a matter of contract. For this reason, they are to be published as part of the addenda to the RFP.

5.8 Phase VI. Proposal Evaluation

The proposal evaluation process identifies the proposal most advantageous and providing the greatest value to the owner. The evaluation process ensures that a proposal conforms to specified RFP requirements, rates the proposals technical performance and price, forms the basis for a recommendation for contract award and forwards that recommendation. During the proposal stage of evaluation it is not feasible to verify conformance with all RFP requirements and criteria. Conformance with the RFP requirements occurs throughout the project including the evaluation stage, contractor's final design review and

construction shop drawing review. To insure fairness among proposers, price information and proposers identification are excluded from technical evaluation documents. Additionally proposals are not compared with other proposals.

The purpose of the evaluation activity is

- To develop an evaluation scheme by which the owner can make a good choice of a contractor. Good choice means the proposer will provide a responsive, quality product at a fair price
- The final selection must be defensible, objective, and convey a sense of propriety to the facility users, owners and proposers
- The evaluation scheme should assist the proposer with understanding owner priorities

Typical Proposal selection criteria

- Architectural image and character
- Alternate for engineering project: technical innovation and environmental acceptability of engineered solution
- Functional efficiency and flexibility
- Quality of materials and systems
- Quantity of usable area
- Access
- Safety and security
- Energy conservation
- Operation and maintenance costs

- Cost/value comparison
- Competition schedule

Proposal Evaluation and Selection methods

The proposal can be evaluated and selected by the following methods as shown in fig: 5.7.

Weighted Criteria

- The owner establishes in the RFP a point rating for qualitative factors and for price
- The owner receives the qualitative proposals and price proposals simultaneously in a separated envelope
- The owner reviews each proposal and may hear oral presentations from each proposer
- The owner then assigns points on a scoring matrix for the proposer's responses to each evaluation factor
- After the design and qualitative factors are evaluated, the price proposals are evaluated
- Maximum price points are assigned to the lowest dollar bid, and all others are scaled inversely proportional to that amount. High total points then determine the successful proposal

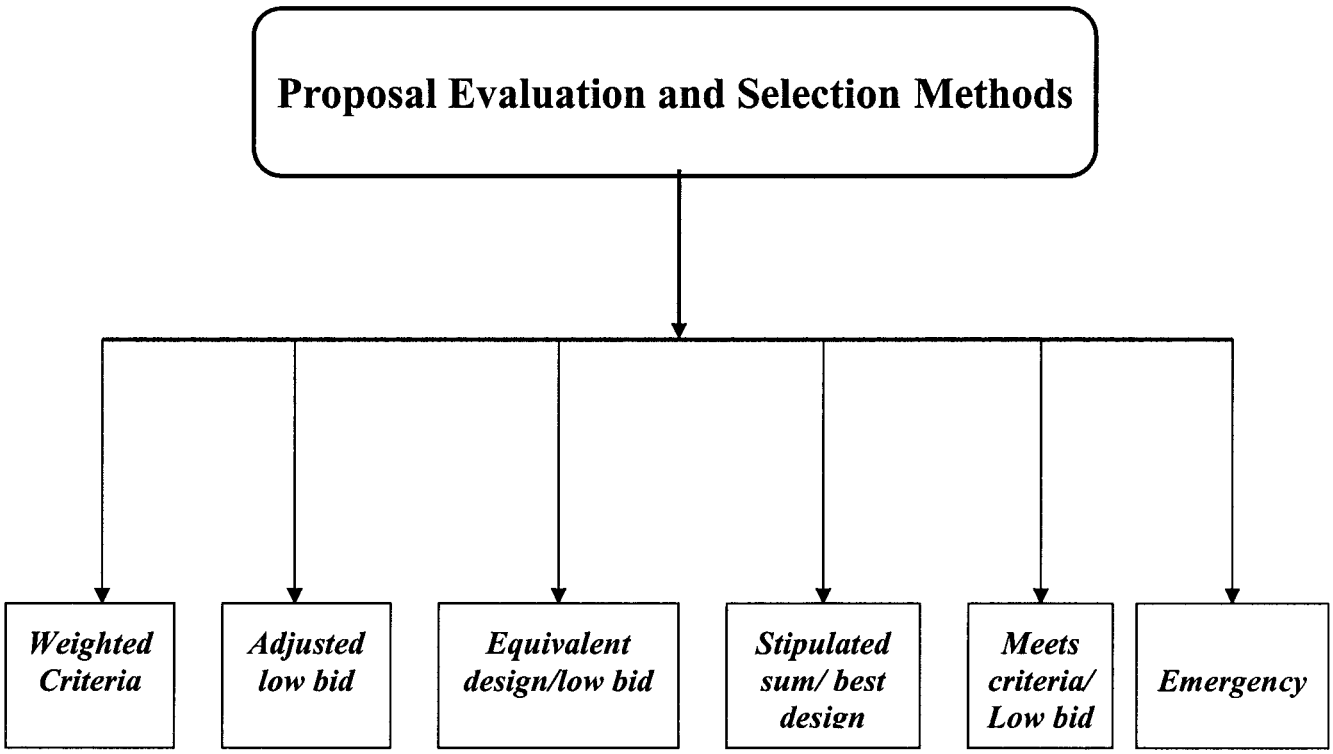


Figure 5.7: Proposal Evaluation Methods

Adjusted low bid

- After the oral presentations, qualitative aspects are scored and totaled on a scale of 0 to 100, expressed as decimals
- Price proposals are then divided by the decimal score to yield an adjusted bid
- The lowest adjusted bid is recommended for contract award
- The adjustment to the bid price is for selection only. The firm's initial proposal price is the actual contract amount

Equivalent design/low bid

- Design proposals are followed by a separate critique session with the individual design-build teams
- Proposers are given a deadline to respond to the critique wit specific design changes
- The revised design proposals are accompanied by a corresponding price adjustment (either add or deduct)
- The design proposals, along with base bid and revised bid are evaluated by the owner
- Award then can be made with heavy or exclusive emphasis on price because the proposal critique should have created relatively equivalent designs

Stipulated sum/ best design

- The short listed proposers submit their qualitative proposals
- The owner uses its equivalent criteria to score the proposals

- Recommendations for contract award are made for the firm offering the best design solution for the fixed budget amount

Meets criteria/low bid

- This method of evaluation most closely resembles the traditional design-bid-build process
- Typically the RFP criteria allow very little creativity in the proposed design solutions
- Very specific outline or conceptual designs are issued as part of the design criteria package
- Proposals are solicited from qualified firms
- The proposals are evaluated and deemed to meet the criteria and award is made to the lowest bidder

Emergency

- When public safety and welfare are threatened, the owner may authorize negotiations with the best-qualified design-builder available at the time
- The owner may utilize references, capability, and/or previous experience with the firm to justify the selection

This phase is completed when a DB contract is signed and the selected proposer is issued a notice to proceed with the design work after the submittal of required bonds and certificates of insurance.

5.9 Phase VII: Perform Contract Administration

This phase of the DB process includes management activities required to ensure proper implementation of the contract. Theses include preconstruction, construction and post construction contract administration

Perform pre-construction contract administration includes conducting preconstruction conferences and design review and approvals. The approval of final design and construction documentation is completed during these activities. This varies from the traditional contracting approach in which these activities are completed in the design phase prior to award of a construction contract.

Upon completion of the contractor's construction documents, construction contract administration is performed in a similar fashion as traditional projects. Activities included in Perform construction administration are receive and review shop drawings, Perform Quality Assurance, Process Change Orders, and Perform payment processing.

Post construction contract administration activities are also conducted in a similar fashion as traditional projects. Sub activities for perform post construction administration include conducting beneficial occupancy and project closeout activities.

CHAPTER 6

DESIGN BUILD IMPLEMENTATION SOFTWARE TOOL

6.1 Introduction

A Design-Build model was developed in the previous chapter. The model described the procedural framework that the various project participants can use for the effective implementation of the Design-Build method. The model was divided into 7 distinct phases. The sub-factors under each phase were then explained in detail. This chapter explains the development of a software tool based on the model, which will assist owners and other project participants to take into consideration all the elements involved in a competitive Design-Build method starting from identifying facilities for Design-Build to final implementation of the contract.

6.2 Development of a Software Tool

A software tool to implement Design-Build method was developed using HTML. HTML stands for "Hyper Text Markup Language". HTML uses a set of tags to describe how text, pictures, and other elements are arranged on a page. These tags indicate where text should

appear in bold, where a paragraph break occurs, hypertext links to other pages and more. HTML elements define the way Web pages are presented. Web browsers interpret individual HTML elements and display them on the computer screen. These elements are HTML tags. In the development of the software tool, links are created under each element of all the phases of the model, and this will guide the owner through the whole process of Design-Build implementation. The model is divided into the following phases:

- Identification of Facilities for Design-Build
- Program Definition
- Request for Qualification
- Prequalification
- Request for Proposal
- Proposal Evaluation
- Performance of Contract Administration

Figure 6.1. Welcome Screen of the Software Tool

The following screen will be displayed when the user opens the software tool. On clicking "Design-Build Implementation Tool", all the phases involved in the tool are displayed. The user then can navigate through all the phases in detail.

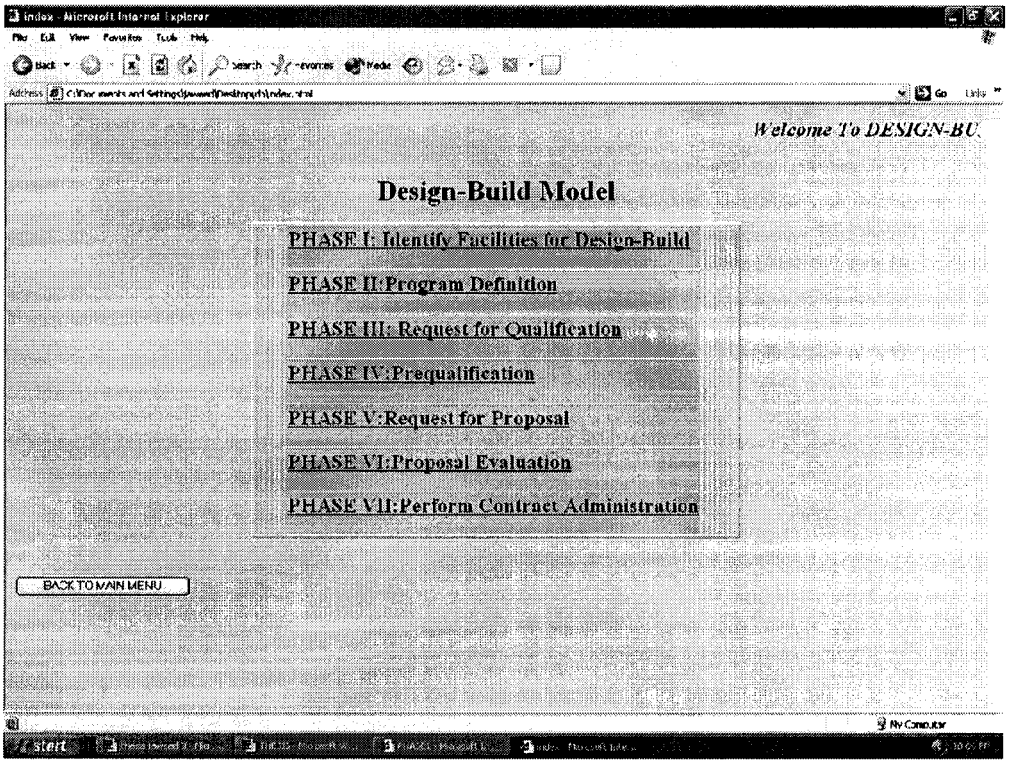


Figure 6.2. Phases of the Model

The seven phases of the model are displayed on the tool. The tool guides the user through the whole process from phase I to phase VII in order. The elements in each phase and their sub-factors are described in considerable detail in the model.

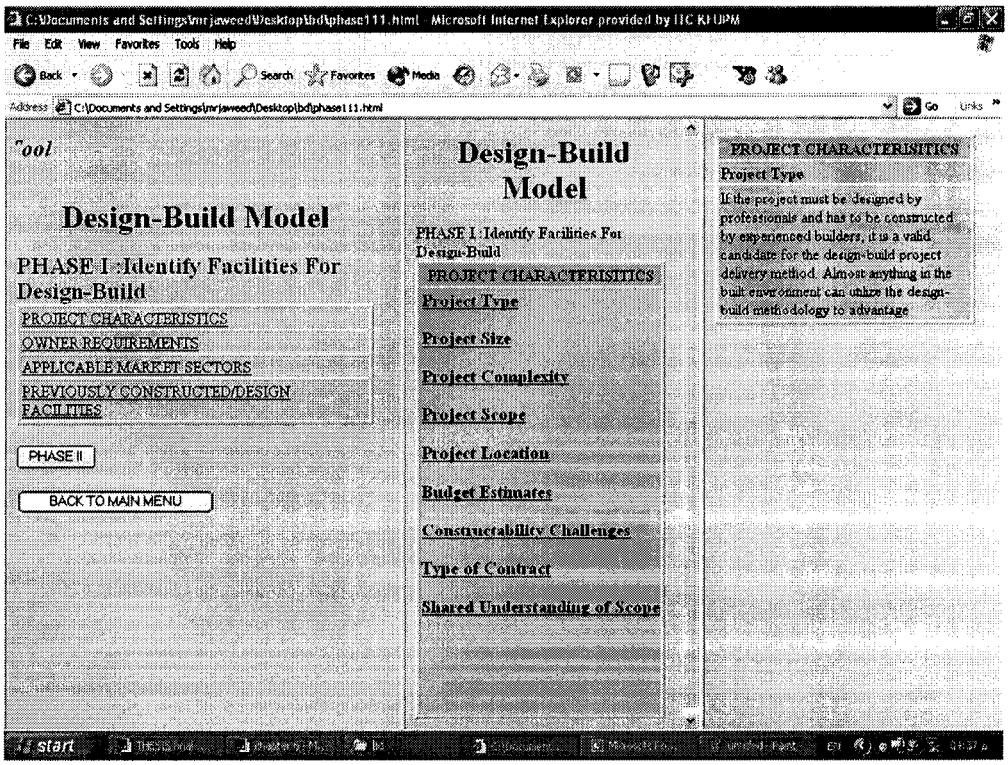


Figure 6.3. Phase I of the Model

The elements involved in phase I are displayed. Phase I contains 4 major categories which further contain sub-elements. These are the information elements which give detailed information regarding the feasibility of implementing Design-Build. Once the user decides to implement Design-Build, he proceeds to phase II of the model.

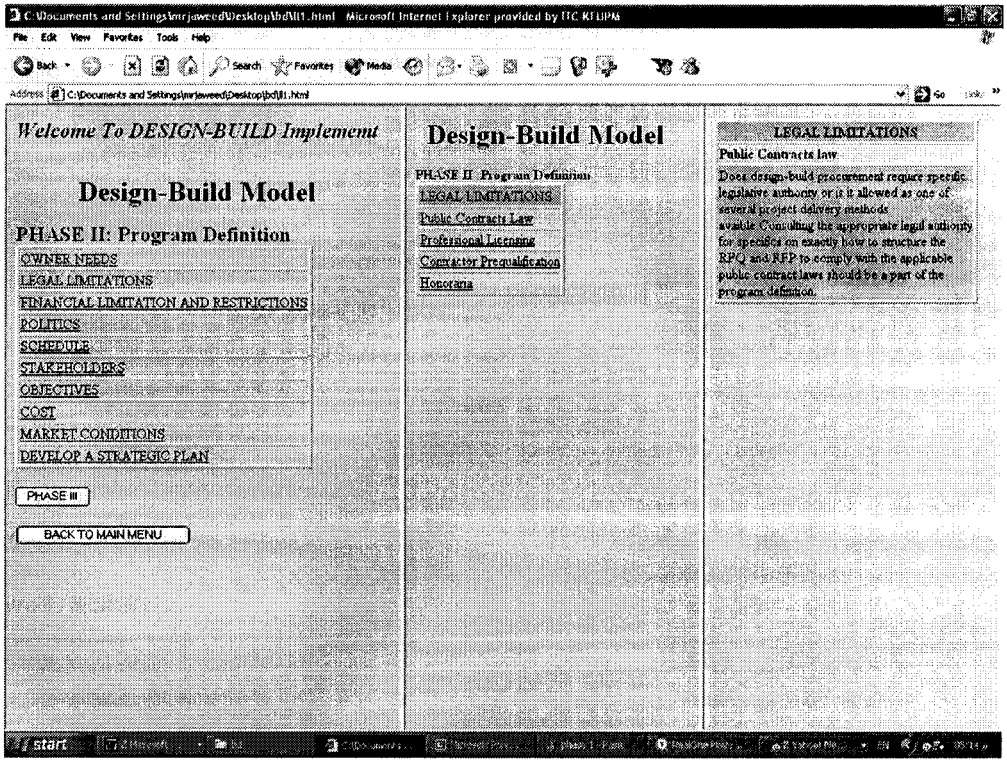


Figure 6.4. Phase II of the Model

Phase II of the model gives detailed information regarding program definition. Phase II is divided into 10 major categories which further contain sub-categories. Each sub-category is then further defined in detail, which guides the owner in defining his program. An invariable prerequisite of the Design-Build method is that the owner's needs must be described precisely and in a manner that will be universally understood. This phase of the tool will help the owner in achieving that goal.

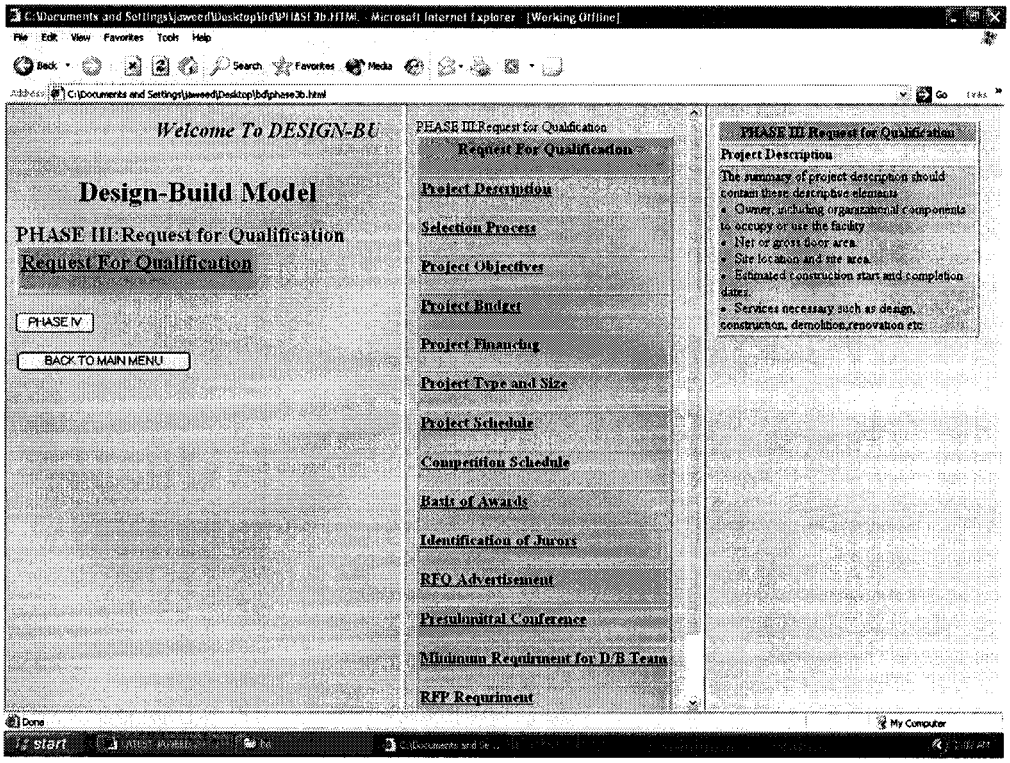


Figure 6.5. Phase III of the Model

Phase III of the tool, called Request for Qualification, gives detailed and complete information regarding the necessary and desirable qualifications which the owner has to obtain from Design-Builders wishing to be considered for the competitive proposal. The project outline is the owner's first opportunity to attract the targeted Design-Builders.

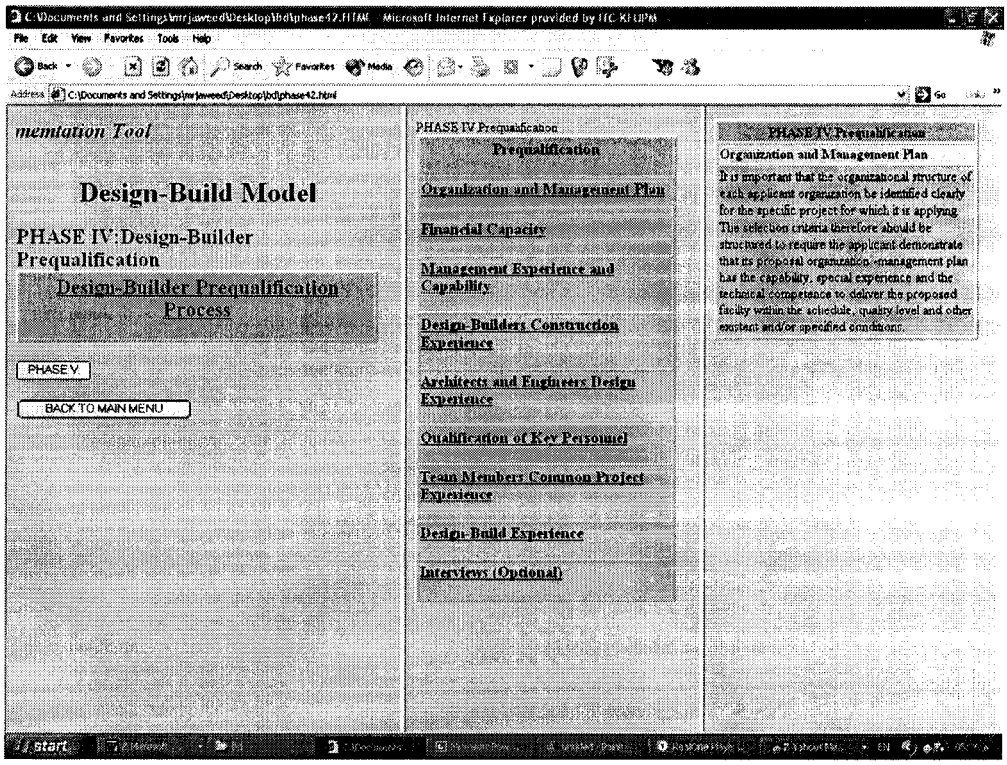


Figure 6.6. Phase IV of the Model

Phase IV of the tool gives detailed information of how the Design-Builder would be prequalified.On clicking each sub-element, further information regarding the prequalification process can be obtained. The ability of the Design-Builder to successfully complete the project efficiently and on time is a key attribute that an owner must consider when evaluating prospective Design-Build proposers.

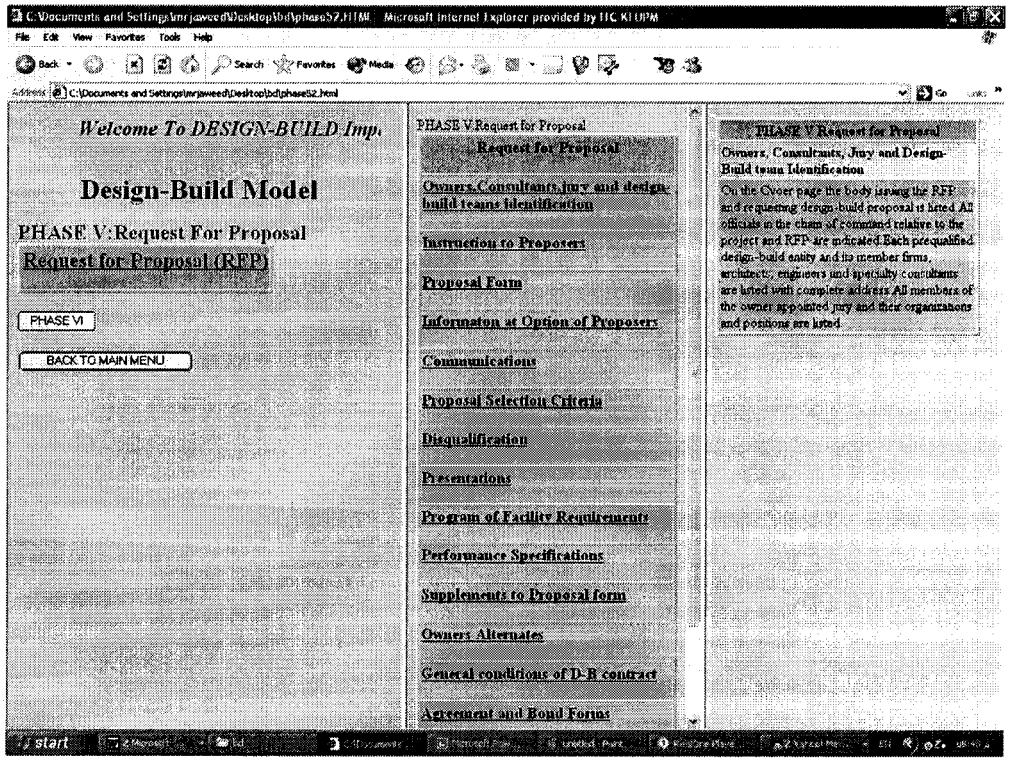


Figure 6.7. Phase V of the Model

This phase gives the information to be provided to the prequalified Design-Builders in the form of Request for Proposal.(RFP) RFP is the primary communication tool for conveying the owner's goals and objectives to the design-builder.RFP should remain as open to design as is reasonable. This allows creativity from proposal responses. Specification for the Design-Build proposal must be developed as performance specification combined with prescriptive specification that allows the construction industry the opportunity to propose a variety of design and technical solutions.

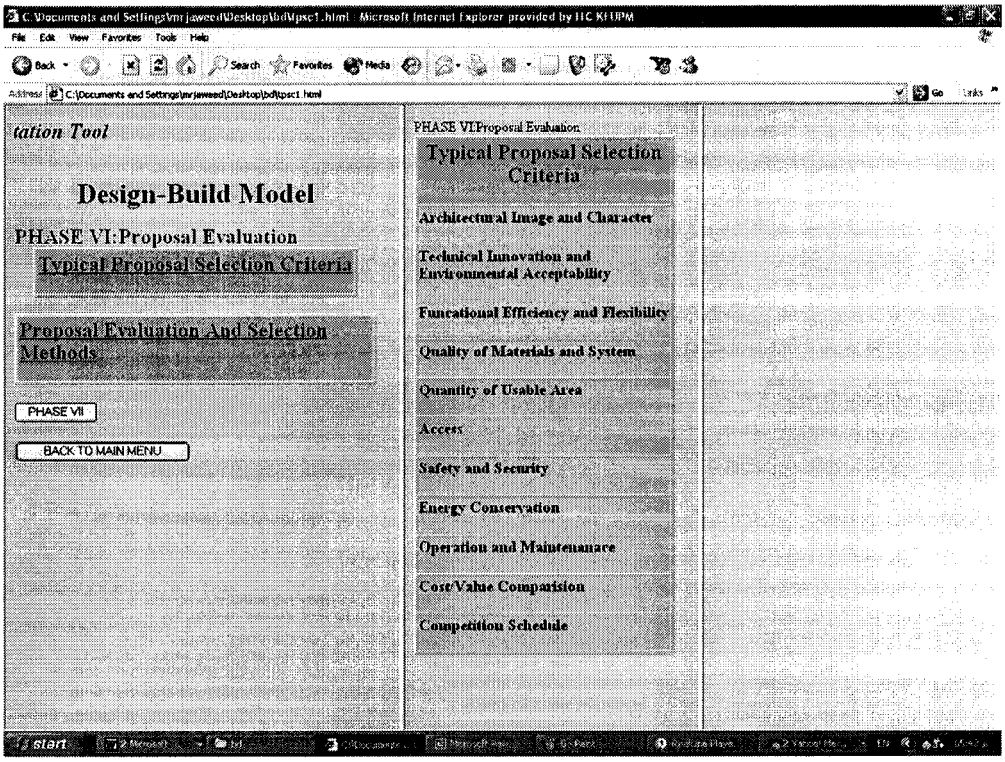


Figure 6.8. Phase VI of the Model: Typical Proposal Selection Criteria

In phase VI, proposals received are evaluated. This involves identifying the proposal which is most advantageous and which provides the greatest value to the owner. The information regarding each evaluation element can be obtained by clicking the element. Different evaluation procedures are mentioned which can be used depending on project conditions, owner requirements and available time. The figure above shows the criteria on which the proposals are evaluated.

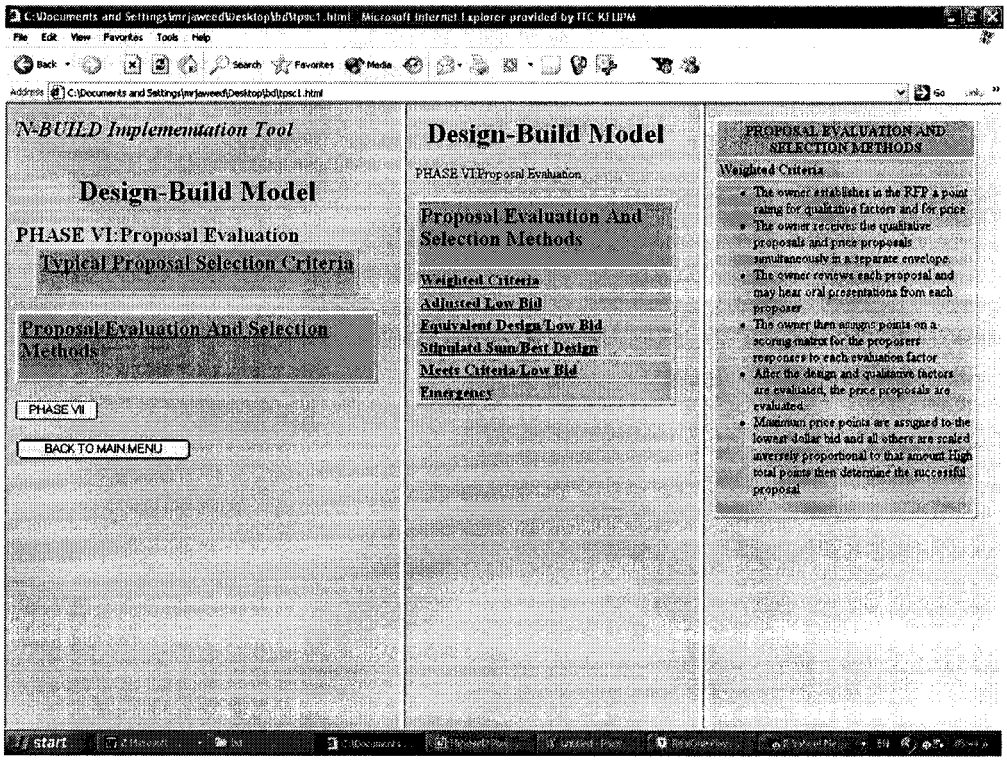


Figure 6.9. Phase VI of the Model: Proposal Evaluation and Selection Method

The above figure of the software tool shows the various methods by which the proposal can be evaluated depending upon project conditions, owner requirements and available time. On clicking each method, a detailed description of that particular method is given, which will assist the user in its implementation.

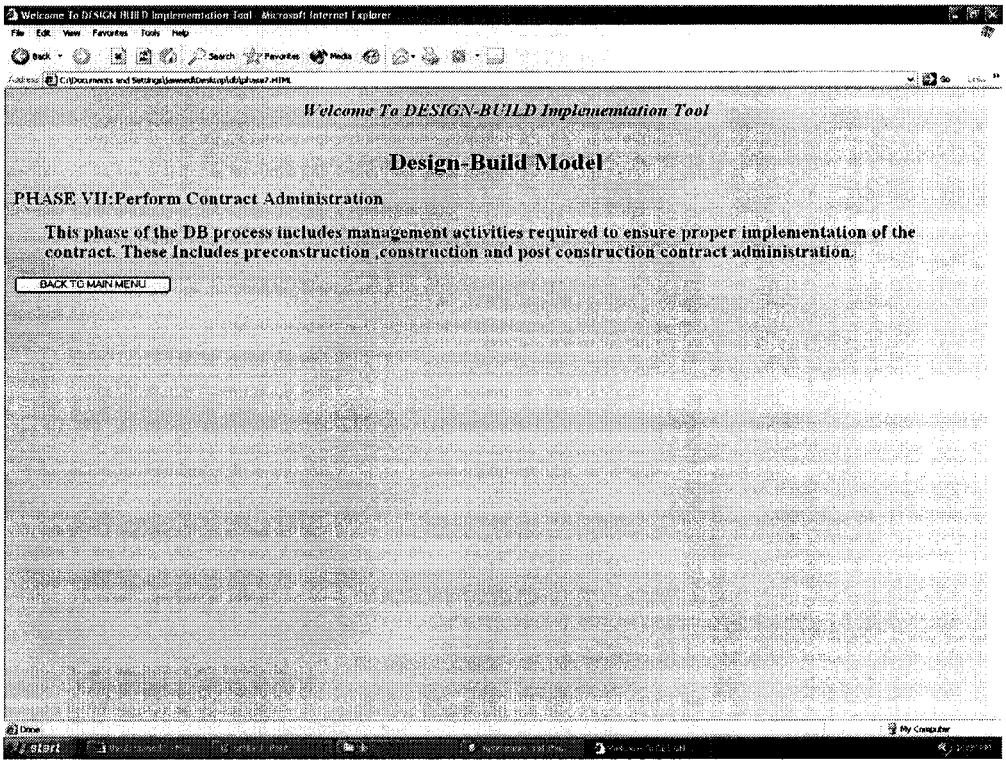


Figure 6.10. Phase VII of the Model

This is the final phase of the model. Once the qualified Design-Builder is selected, this phase of the Design-Build software tool will help in the management activities required to ensure proper implementation of the contract. These include preconstruction, construction and post contract administration.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary

The study is divided into 7 chapters. In chapter 1 the importance of a healthy construction industry and the use of an appropriate project delivery method as one of the key factors contributing to project success are discussed. It is observed that, though the projects have become complex, less time and cost has been allocated in the designing, bidding, planning and construction of building projects. The study showed that the construction industry faces formidable challenges and there is room for substantial improvement for the industry. Also discussed is the increase in the use of the Design-Build project delivery method in recent times and the entry into the market by contractors and architects-engineers with little or no design experience. Hence the need to develop a model for the Design-Build project delivery method is realized.

In chapter 2 an extensive review of the evolution, classification and types of project delivery method is done. Various project delivery selection models are studied. Different types of project delivery methods with their advantages and disadvantages are reviewed.

In chapter 3 the methodology adopted in achieving the stated objective was explained. The methodology was grouped into 4 phases: literature review, identification of factors affecting the use of Design-Build project delivery method, development of the model, and creating a software tool for effective implementation of the Design-Build project delivery method.

In chapter 4 detail and extensive literature review of the Design-Build project delivery method is done. Design-Build history, its increased use in recent times, and positive and negative factors affecting its use are studied. Comparison of the Design-Build project delivery method with other methods is discussed. Also the responsibilities of project participants, variations and challenges in the Design-Build project delivery method are studied.

In chapter 5 the Design-Build model is developed from the literature review. The model is divided into 7 distinct phases. Each phase is explained in complete detail. The phases in the model are: identification of facilities for design-build, program definition, request for qualification, prequalification, request for proposal, proposal evaluation and performance of contract administration.

In chapter 6 the Design-Build implementation software tool is developed. This is based on the model discussed in the previous chapters in which all the phases in the Design-Build model are explained. Explanation of all the elements in each phase is depicted in the software tool.

7.2 Conclusion

It is concluded from the research that the construction industry faces formidable challenges. The construction industry performs unsatisfactorily and suffers from low profit margin and persistent project overruns in schedule and budget. It is also plagued with claims and counter claims. The use of an appropriate project delivery method is one of the key areas for the improvement of the industry.

The Design-Build project delivery method has experienced extraordinary growth in recent years. The US Department of Commerce predicts that Design-Build will account for half of all non-residential construction by the year 2001. A questionnaire survey carried out in Saudi Arabia to select the most appropriate procurement system for the implementation of their projects showed that Saudi public clients selected Design-Build as the most appropriate procurement system for their projects which indicates that there will be substantial growth in the use of Design-Build in Saudi Arabia.

As new participants are entering into the Design-Build market, there is a need to document and disseminate fundamental Design-Build knowledge. The increased understanding of Design-Build project delivery will help in successful implementation of this fast growing project delivery method. Also dissonances in the construction industry can be overcome by the use of the Design-Build project delivery method as the project is managed by a single entity to ensure the achievability of required goals.

The above observation led to the development of a model which will guide the project participants in effectively implementing the Design-Build project delivery method. Also the software tool developed based on the model will help the project participants to utilize the Design-Build project to its full advantage.

7.3 Recommendations

The Design-Build method is gaining popularity as an attractive and desirable project delivery method for all types of projects. The method offers a single source of responsibility. The Design-Builder has absolute accountability for both design and construction. Informed owners are asking practitioners to take more than just artistic interest in their facilities. The required comprehensive services can be provided by the Design-Build method.

The Design-Build method can be used for the advantages it offers compared to other delivery methods. Benefits to be gained are a single source of responsibility, reduced cost, reduced time, innovation, established cost, established schedule, reduced claims, constructability , value engineering application, improved quality, potential for reduced administration burden, improved risk management and improved productivity.

The use of the Design-Build process provides one with the means to overcome some of the fragmentation in the construction industry. The team approach helps to overcome adversarial relationships which, in turn, creates shared goals which benefits all parties involved.

The present day multiple needs and complexities of the construction industry make the use of the Design-Build approach appropriate. The contractor is involved in the project at the design stage itself. This helps to improve design on reality grounds and develop better coordination among professionals.

7.4 Future Studies

Research could be carried out to obtain owners', contractors' and designers' attitudes towards the Design-Build approach. A questionnaire survey of project characteristics and selection factors favoring the use of Design-Build would be beneficial in the more effective use of the method. A comparison study of Design-Bid-Build, Design-Build and construction management at risk project delivery methods in terms of cost, quality and schedule will help in determining actual performance of each delivery method. As there is a rapid increase in the utilization of the Design-Build project delivery method, a continuous education program can be provided to owners, designers and builders to facilitate its use in the construction industry.

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